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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Editorial Publicity

This subject was very intelligently dealt with at a recent meeting of the Incorporated Society of British Advertisers (Technical and Trade Press Section) by Mr. W. H. Temple, advertising manager of Ruston & Hornsby, Limited, of Lincoln. It bristles with difficulties, but these are minimised by adhering to basic principles. It is essential that reader-interest be maintained, for without it any paper obviously loses its value as an advertising medium, and what is of real interest is best known to the editor. As Mr. Temple stresses, readers definitely dislike "tainted news," but he points out that "news is news, whatever its source. It is pure news if it is true, and tainted only if it be untrue, either in fact or in implication." Thus, descriptions of new machinery constitute an item of news which the readers have every right to expect in their trade paper, the advertising columns carrying additional information. This service should, and is, carried out by the best journals without reference to whether the plant in question has been developed by an advertiser or a non-advertiser. "But," according to Mr. Temple, "human nature is what it is, and the running of a technical journal is, in the final analysis, a commercial proposition. It is only natural, therefore, that there should be some link between the editorial and advertising sections. In the foremost journals this link is a very weak one. In some of the less reputable journals the connection is blatant."

We were impressed with Mr. Temple's guiding principles for gaining editorial publicity. He insists that "courtesy is, of course, essential. The editor has a responsibility to his readers, and, however much we may disagree with him, we must defer to his decisions regarding his paper—and if a protest is ever necessary, it should be stated with respect." The type of publicity to which we object is the "mass-produced" variety. Some firms "release" an article about their products to the whole of the technical Press in the hope that some editors will accept it. The technical Press is in general quite specialised, and it is not an insuperable difficulty for the publicity managers to learn the nature of this specialisation and to adjust their articles to take cognisance of it in exactly the same way as does a free-lance journalist. This point was well brought out by Mr. Temple's lecture. Unquestionably, much of real news value is originated by the suppliers of machinery to any industry, but such development must be presented in a manner which conforms to the standard set by the editorial policy. Only last Saturday night we turned off the wireless because of the excessive personal publicity sought by a music hall turn. In another case, in reading a house organ, personal nausea was induced by the constant adjectival reiteration—something of the order of twenty times on a page—of the name of the issuing house. Mr. Temple has certainly expressed, for the first time we believe, much that is uppermost in the minds of editors of the more responsible technical Press.

The Tower of Babel—II

Some of the questions raised in our last issue on translating problems were recently answered in a Paper on technical translations given to the last Aslib conference by Dr. J. E. Holmstrom. He suggested that a first principle ought to be the translation of ideas rather than words. A technical translator should therefore be possessed of technical knowledge, should know the language of the original, and should be able to convert it into good English. He must be aware of words in the two languages concerned, which are the same, or similar, and yet have different meanings; he can point out errors in the original, and he can convert quantities, units and symbols where it would help the English reader. In the discussion, a code of translation practice was advocated, the principal points being that a translation should express the author's meaning rather than his words, and that as far as possible symbols should be expressed in the way common in English, preferably using B.S.I. recommendations where they are appropriate. The general consensus of opinion was that it was more important for a translator to know the subject than the language, although it is in a large organisation quite easy to arrange collaboration so that both a linguist and a technical specialist share in the responsibility for the completed work.

The question of overlapping in translations and in abstracting them is a more difficult one to settle, but so far as the latter is concerned we do not agree that there is as much real overlapping as is sometimes supposed. Because several agencies, usually technical institutions or associations, abstract a Paper, it does not follow that there is duplication, because each has regard to the point of view of its own readers, and it is imperative that the attitude of the reader or prospective reader should be taken into account. On the other hand, there is everything to be said for plans which will make it unnecessary for any technical article to be translated into English more than once, or by more than one agency.

C

Spelter Prospects

BY "ONLOOKER."

All the non-ferrous metals distinguished themselves last year by achieving almost unheard-of variations in value. On a percentage basis spelter tops the list, for after climbing to £37 it fell back to £15, and at the time of writing looks as if it might well be heading for a level even lower than that. This loss in value of about 60 per cent. from the high level achieved in March has occurred in the face of an ever-growing scarcity of high-grade brands, and, incidentally, of Empire prime western quality, too, a development which certainly takes some explaining away. In addition there has been a real shortage in the United States of electrolytic spelter, so much so that approximately 20,000 tons of zinc were imported by that country during the late summer and autumn. In America, too, the quotation has declined latterly, and judging by the big increase in stocks at the end of November there is no longer any fear of a famine across the Atlantic; indeed, so many contradictions are there in the spelter situation that it is hard to resist the belief that at some stage of the proceedings metal has been taken off the market and specially stored. In this connection it may be remembered that there were rumours about the British Government buying, but whether any such action was taken remains in doubt.

Whatever the facts the results are the same, and for some months now we have had such a scarcity of high-grade spelter that buyers in many cases have had to pay stiff premiums for supplies. These high prices, it should be noted, have not been asked by the Empire producers on first sale, for all high-grade metal sold by them in this country has gone out on the basis of a premium of £2 10s. over market G.O.B. Abroad, very high premiums are believed to have been paid, and at one time Japan was reported to be bidding at the rate of £9 over for electrolytic brands. Russia was also a buyer. In this country the brass trade keeps very busy and in consequence demand for spelter, particularly of high grade, is high, but the galvanising industry is unfortunately not so active and from that direction the call for spelter is most disappointing. However, judging by the Board of Trade returns for the first eleven months of last year we used more spelter in 1937 than we did in 1936, for the figures show quite a useful increase. As to the outlook for 1938, the writer cannot see that things are too bad, if only because the very reasonable price at which the metal stands should certainly encourage consumption in all directions.

That spelter has fallen as far as it has is something of a puzzle, for, as already pointed out, demand, at any rate for high grade, is in excess of supplies, and there is nowhere any overwhelming burden of stocks to depress the market. Much of the fall in spelter must undoubtedly be ascribed to adverse sentiment due to the collapse in the quotations of tin and copper, to bear selling and the lack of enterprise by speculators operating for the rise. Why is it that producers have not cut down output in view of the very low price now ruling? Are they losing money at this level or do costs of production make a profit possible? What one has to remember with spelter is that it is more often than not produced in conjunction with other metals as the outcome of mining complex ores, and that therefore in many instances it may be regarded as a by-product, to be turned out willy nilly. Here, then, is one good reason why supplies of G.O.B. brands are plentiful and likely to remain so. In such circumstances it would be foolish to look for much improvement in the price level during the coming months.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Custom of the Trade

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We sent out two special alloy castings to a firm of engineers to be machined. The machinists knew that the castings were a special iron alloy. They were supplied with drawings showing sizes and limits, but when the work was finished it was found that the machining was out of truth, being oval instead of round, and useless for the purpose they were required, with the result that we had to procure fresh castings (value £30) and do the work ourselves.

Whilst the firm which did the work have withdrawn their charge for the work they have done, they decline any responsibility for the damage done to the castings, pleading "custom of trade."

As we do not know of any custom of trade that would allow good castings to be spoilt without any responsibility to the firm which spoilt them, we should be glad to hear if you know of any such custom of the trade, as if it applies at all it might equally well apply to castings which cost £100, instead of £30.

As your readers must be vitally interested in castings, and incidentally the machining thereof, it would be interesting to have some opinions as to what custom of the trade permits and what it does not permit.

Yours, etc.,
"INQUIRER."

P.S.—There is no question of the castings being faulty.

New Year's Honours

The list of New Year's Honours conferred by the King contains a number of names prominently associated with the foundry industry.

LORD NUFFIELD, now a viscount, is, as chairman of Morris Motors, Limited, one of the largest foundry owners in the Midlands.

SIR PERCIVAL PERRY, who has been created a baron, is head of the Ford Motor interests in Great Britain, and thus controls the largest foundry in the London area.

MR. CHARLES BRUCE-GARDNER, who received a knighthood, is chairman of Armstrong-Whitworth Securities Company, Limited, a concern controlling several large foundry companies.

MR. WILLIAM REAVELL, who has also received a knighthood, was President of the British Engineers' Association from 1930 to 1936. He presided with distinction over the Institution of Mechanical Engineers in 1927, and is a past-chairman of the British Standards Institution. He is founder and managing director of the Ipswich foundry and engineering concern, Reavell & Company, Limited.

MR. D. R. WILSON, H.M. Chief Inspector of Factories, has received a knighthood,

SIR ANDREW RAE DUNCAN, who has been awarded the G.B.E., is chairman of the British Iron and Steel Corporation.

DR. J. W. MELLOR, F.R.S., who has been given the C.B.E., is the leading British authority on ceramics. Only recently he resigned the presidency of The Institute of Vitreous Enamellers, a position he held since its inception four years ago. He was Principal of the Stoke Technical College for many years, and created the British Refractories Research Association, and became its director.

MR. A. L. HETHERINGTON, who also receives the C.B.E., is assistant secretary of the Department of Scientific and Industrial Research, and by virtue of this position is well known in industry through the various research departments, as many have accorded him a seat on their councils.

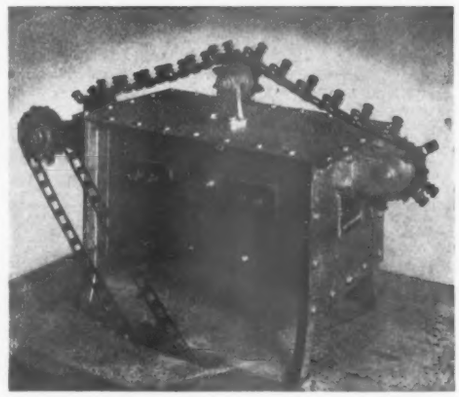
Random Shots

Some years ago a firm of corset manufacturers put forward a competition for the best advertising slogan, and the brightest entry of all was turned down by an unenterprising judging committee. With the slogan "The right figure at the right figure" those corsets ought to have sold like hot cakes. Later a number of dull-witted committees have chosen "eat more butter, or cheese or eggs or the like" as the catch word to snatch the money from the harrassed housewife's purse. Now, at last, even the foundry industry has been bitten by this sloganising bug, and it is to be hoped that the organisers of the competition for a slogan for cast iron will show more imagination than most and will like something really snappy. The Editor has already given a valuable "leader" on the subject. The best slogan, says he, should possess the qualities of brevity, action, and possibly alliteration. The "eat more's" and the "is best's" seem to carry the day. Well, then, as one cannot "eat more cast iron" except at boarding-house dinner tables, one can easily "choose more cast iron," and in this slogan are all the desired qualities; brevity, action, and alliteration complete. From the Editor's reckoning, here is the one and only perfect slogan, and "Marksman's" fee for use of the suggestion is 10 per cent. of the prize money, for he doesn't propose to make use of it himself. It is quite conceivable that such an enterprising body as the B.I.A. might rank novelty above everything else. One is weary unto death of the above mentioned "eat more's" and "is best's," and "Marksman" himself has a fancy for the type used freely and so effectively by "Bovril." The light fantastic touch, the play upon words, make a more lasting appeal to an intelligent public, the very section of the community to whom the appeal is directed. "Marksman's" entry, therefore, quite definitely will be, unless a brighter idea comes in the small hours of the night, "Cast your eyeon on cast iron," and the idea is copyright until then. Even a 10s. consolation prize will provide for a few weeks' flutter with the football pools, and with a £100 one could veritably go to the dogs.

"MARKSMAN."

A Heat-Resistance Demonstration Unit

This animated exhibit was shown by the nickel interests at the Paris Exhibition to demonstrate the resistance of nickel alloys to high temperature. The endless chain links and the bright test



pieces are made of a nickel-chromium iron alloy containing 60 per cent. nickel and 15 per cent. chromium. They are unaltered by heating to 900 deg. C., while the plain carbon steel test pieces opposite the nickel-chromium pieces are much oxidised.

Recent Progress in Nickel Steel Castings

Improvements in foundry technique combined with alloy additions and proper heat-treatment have removed any suspicion under which castings may have suffered in the past. The tendency to turn away from the more convenient casting to the forging, due to the belief that the latter was more reliable, has been checked, and to-day, by the use of alloying elements, especially nickel, either alone or in association with other elements such as manganese, chromium, molybdenum, etc., it is possible to produce castings having properties that enable them to be applied in many spheres of engineering.

The addition of nickel to steel castings improves the toughness, refines the grain and enables the material to respond more easily and effectively to heat-treatment. Not only are these improvements in the mechanical properties obtained, however, but owing to the greater penetration of the effects of heat-treatment, they are maintained with greater uniformity throughout thick and thin sections.

Even in small percentages, nickel can be used to give improved toughness to large as well as small castings. Moreover, not only does nickel produce toughness, but it enables this property to be retained at low temperatures. These factors are of special value in a wide range of applications, for example, propellers for ships operating in the colder latitudes.

Weight Reduction without Loss of Strength

The superior tensile strength provided by the nickel content has enabled reductions to be made in weight without any sacrifice of the factor of safety; conversely, increased strength and toughness can be obtained in existing sections, so making it unnecessary to alter patterns. This is due to the fact that nickel effectively raises the ratio of the yield point to the maximum stress, which, in the case of carbon steels, is relatively low. The value of nickel in improving the yield ratio is increased by the presence of chromium and molybdenum.

Uniformity through Varying Sections

In the case of large components, the designer must be able to rely upon obtaining mechanical properties which remain relatively constant in both thick and thin sections. This may be achieved by the use of nickel steel, since the addition of nickel produces a fine grain, also permitting a greater penetration in large sections with heat-treatment. The presence of chromium and molybdenum helps to increase the depth of this penetration.

Wear and Shock Resistance

Resistance to wear is frequently obtained by means of hardness, but this property is usually associated with brittleness. The addition of nickel has been found, however, to maintain the resistance to abrasion, whilst at the same time it provides a good degree of ductility and toughness, thus conferring good resistance to shock and fatigue stresses.

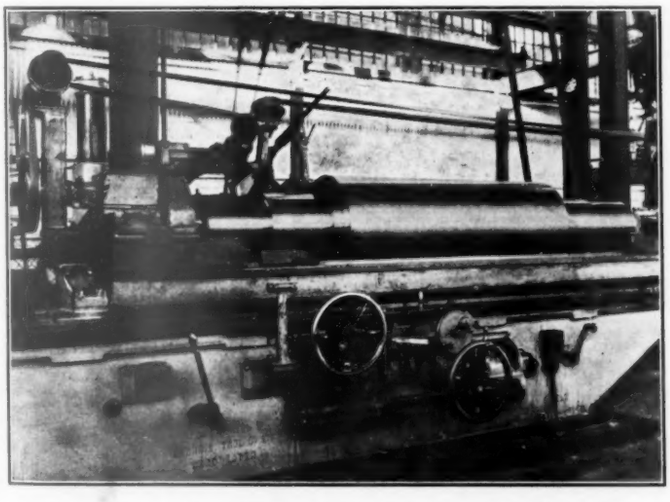
For example, a successful use of nickel steels is for special railway trackwork in the form of frogs and crossings. Their use in this connection is due to their high resistance to abrasion and shock, combined with a sufficiently high yield-point to withstand flowing under compressive stresses. Further, they can be very satisfactorily "built-up" and joined by "thermit" welding.

Table I shows the chemical compositions, heat-treatment and mechanical properties of 11 types of cast steel, whilst Table II gives typical applications of these materials. Accompanying

TABLE I.—*Types of Cast Steels.*

	Steel.	A.	B.	C.	D.	E.	F.	G.	H.	J.	K.	L.
Chemical composition, per cent.	C	0.2 max.	0.2–0.3	0.25–0.35	0.3–0.4	0.3–0.35	0.25–0.35	0.3–0.5	0.25–0.35	0.5–0.6	0.4–0.6	0.6–0.8
	Si	0.15 min.	0.25–0.4	0.45 max.	0.25–0.4	—	—	—	—	—	—	—
	Mn	0.6–0.9	0.7–1.0	1.0–1.5	0.6–0.9	0.6–0.8	0.4–0.7	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	10.0–15.0
	Ni	2.0 min.	2.0 min.	1.0–1.5	1.25–1.75	1.25–1.75	2.75–3.5	1.25–1.75	1.75–2.25	1.5–2.0	3.0–3.5	3.0–5.0
	Cr	—	—	—	0.6–0.9	—	0.6–0.9	0.6–0.9	0.6–0.9	0.6–1.5	1.0–1.25	—
	Mo	—	—	—	—	0.30–0.35	(0.15–0.3)	—	0.15–0.25	0.3–0.5	0.3–0.5	—
Heat-treatment	Anneal at deg. C.	940*	—	—	930	1,000	900	950	930	‡	900 to 960	—
	Normalise at deg. C.	820 to 850†	900	850	900	925	850	900	900	900	840	900 to 1,000
	Cool in	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
	Temper at deg. C.	600 to 675	650	550 to 650	550 to 675	650 to 730	550 to 650	550 to 650	550 to 650	320 to 430	370 to 430	—
	Cool in	Air or furnace										
Mechanical properties	Y.P., tons sq. in.	20–24.5	22–29	25 min.	27–31	24–29	40–50	27–38	31–33	78–85	—	12§
	M.S., tons sq. in.	33–38	40–47	40 min.	45–50	40–45	50–60	45–53	45–53	90–96	—	47
	E. per cent. in 2 in.	32–25	28–22	22 min.	25–18	28–20	20–12	25–14	25–16	5.5–3.5	—	57
	R.A., per cent.	64–45	55–42	45 min.	48–35	55–40	45–20	48–25	50–35	13.9	—	48
	B.H. No.	—	—	—	205–241	—	—	205–255	205–255	465–500	380–450	—
	Izod ft.-lbs.	80–40	—	—	40–20	—	45–15	—	45–20	—	—	-

* Heat 2 hrs. per in. thickness. † Heat 1½ hrs. per in. thickness.
‡ In cooling from the annealing temperature (900 deg. C), re-apply heat on cooling at 650–680 deg. C. for 1 hr. and then furnace cool. § Limit of proportionality.
N.B.—The sulphur and phosphorus contents should be not more than 0.05 per cent.



RUBBER ROLL CAST IN NI-CR STEEL. IT HAS BEEN OIL-HARDENED FROM 820 DEG. C. AND TEMPERED AT 425 DEG. C.

A 3-YARD ELECTRIC QUARRY SHOVEL IN WHICH NI-CR STEEL CASTINGS ARE EXTENSIVELY USED.

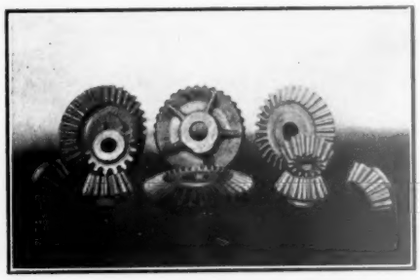
(COURTESY RUSTON BUCYRUS.)

illustrations show a few of the wide range of castings for which nickel alloy steels are especially suited.

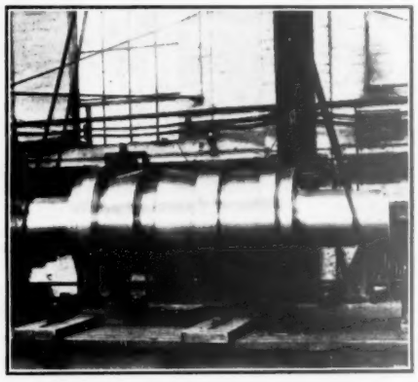
Suitability for Use with High Temperatures

It is now generally accepted that a material in its cast form has a limiting creep-stress superior to that of its wrought form, and, since the modern tendency is to use higher temperatures and pressures, castings are thus receiving increasing attention.

Nickel alloy steels possessing good limiting creep stress values are being used extensively as



ROLLING MILL GEARS MADE FROM NI-CR STEEL CASTINGS.
(COURTESY THOS. FIRTH & JOHN BROWN.)



"ADAMITE" NICKEL ALLOY STEEL ROLL.
(COURTESY R. B. TENNENT, LIMITED.)

castings for valves and fittings, superheater steam bodies and many other components which have to function at elevated temperatures and high pressures. Recent investigations on a series of 15 cast steels of various compositions at temperatures up to 500 deg. C. have shown that the nickel-molybdenum and nickel-chromium-molybdenum steels were superior to the other types tested. Furthermore, the nickel alloy steels possessed the greatest strength, both at ordinary temperatures and at 500 deg. C.

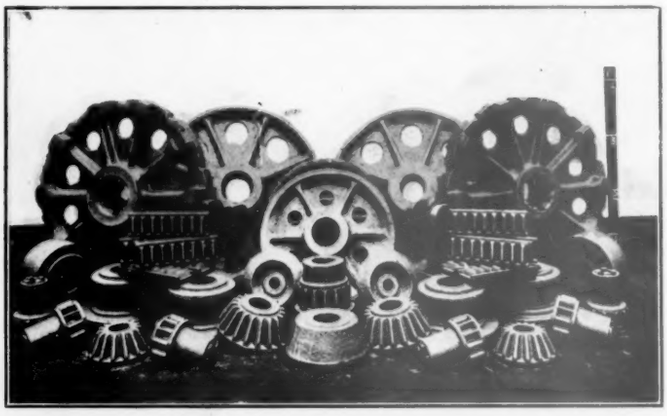
Heat-Treatment

Quite good properties may be obtained in nickel steel castings by an ordinary normalising treatment. If the castings be unusually large, however, or if it be desired to develop the optimum properties, further heat-treatment is advisable.

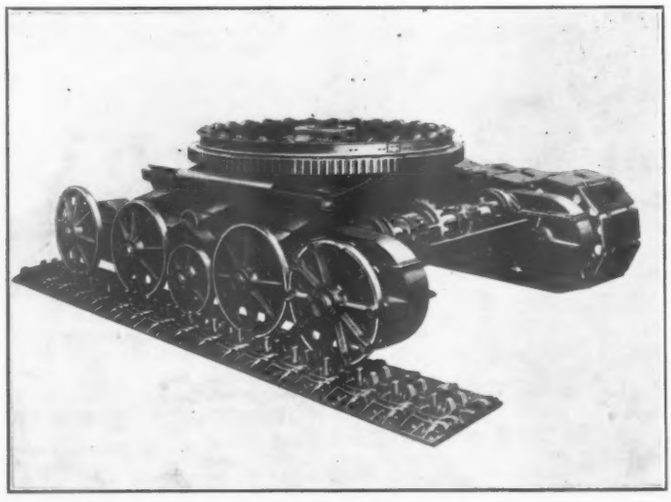
The procedure may be as follows:—The first annealing, sometimes called "homogenising," is

TABLE II.—*Typical Applications of Cast Nickel Alloy Steels.*

Requirements.	Typical applications.	Recommended steel (reference Table I).
Highly-ductile steels, resistant to shock and fatigue at atmospheric and low temperatures	Locomotive frames, castings for mining, excavating and steel mill machinery, ship castings.	Low carbon 2 per cent. nickel steel A.
With somewhat higher carbon than A, increased elastic properties and strength can be obtained	Miscellaneous railway castings, large gears not subjected to severe abrasion, crusher frames, tractor and power shovel frames.	Medium carbon 2 per cent. nickel steel B.
Moderate cost with strength and ductility superior to carbon steels. These steels replace carbon steels when the mechanical properties desired do not warrant the use of higher nickel steels	For stressed members of tractors, motor trucks, road-building machinery, electrical machinery, etc.	Pearlitic nickel-manganese steel C.
Superior mechanical properties in normalised steel castings. For light and medium sections.	Oil-well tools, sheaves, sprockets, tractor shoes, gears, cams, etc.	Nickel-chromium steel D. Nickel-molybdenum steel E.
For medium and heavy sections	Castings for locomotives, rolling mill machinery, highly-stressed gears, power shovels and other machinery subjected to rugged service	Nickel-chromium-molybdenum steel F. Nickel-molybdenum steel E.
Quenched and tempered steel castings with high strength, hardness and wear resistance. For light and heavy sections	Hardened gears, cams, rollers, sprockets, conveyor chain links, etc., oil-well tools, sheaves (these castings are sometimes differentially hardened)	Nickel-chromium steel G. Nickel-chromium-molybdenum steel H.
For medium and heavy sections ..	Highly-stressed gears, pinions, racks, rollers, sprockets and miscellaneous machine parts.	Nickel-chromium-molybdenum steel F.
Abrasion-resistant castings .. For light and medium sections	Particularly adapted for castings which are to be differentially hardened, for example: power shovel teeth, impact hammers. Ball and tube mill liner plates, ore chute liners and other parts not subjected to high impact	Nickel-chromium steel G. Nickel-chromium-molybdenum steel H. Nickel-chromium-molybdenum steel J.
For medium and heavy sections ..	Crusher jaws, dredge pumps, impact hammers, digger teeth, etc.	Nickel-chromium-molybdenum steel K.
Resistance to abrasion under heavy pressure and/or impact. Retention of ductility after exposure to temperatures up to 600 deg. C. Weldability. For light, medium, or heavy sections	Hot bed run-out tables, forming dies for lap welded pipe, draw bench chain for butt weld tube mills, heavy crusher rolls, jaws and liners, railroad crossings	Austenitic nickel-manganese steel L.
Strength and "creep" resistance at elevated temperatures	Valves and fittings, return bends, superheater and heat exchanger heads, cement clinker chain	Nickel-chromium-molybdenum steel H with carbon 0.30–0.40.



GROUP OF NI-CR STEEL CASTINGS.
(COURTESY HADFIELDS, LIMITED.)



UNDERCARRIAGE AND CATERPILLAR FOR A QUARRY SHOVEL.
(COURTESY RUSTON BUCYRUS, LIMITED.)

carried out at a temperature considerably above the critical range in order to break up the heterogeneous "as cast" structure and to replace it by one which is more homogeneous. The actual temperature used will vary according to the composition and to the thickness of the section. The castings are then cooled, and, in order to refine the grain, they are normalised by air-cooling from a temperature just above the upper critical range.

If the castings be complicated in shape or where they are highly alloyed, it is advisable to follow the normalising treatment with a final tempering treatment at temperatures between approximately 550 deg. C. and 650 deg. C.

The combined homogenising, air-quenching and tempering treatment develops in nickel alloy steel castings mechanical properties which compare favourably with those obtained from forged steels. Whilst such heat-treatment is essential for very large castings, the more simple procedure may be followed for castings of smaller sections. In the latter case, the first two treatments are combined into one normalising treatment at a temperature just in excess of the upper critical range; this is followed by tempering.

Treatment for Special Physical Properties

Where special physical properties are required, it may be advisable to follow the homogenising treatment with a quenching and tempering treatment similar to that used for wrought steels; the suitability for quenching of the casting itself must, of course, be taken into account. Incidentally, when castings are in the oil- or water-quenched condition, they should not be roughly handled or allowed to become completely cold before receiving the tempering treatment.

Nickel is of special benefit in connection with heat-treatment operations which demand quenching. The critical rate of cooling necessary to produce complete hardening in a 0.30 per cent. carbon steel is at least 400 deg. C. per sec. If 3 per cent. of nickel be added to the steel, however, the critical rate is reduced to about 40 deg. C. per sec. This explains why a less drastic quench in oil may be substituted for the water-quench necessary for carbon steels. This is, of course, important in the case of large sections which cool slowly and in which strength, ductility and toughness are required. Moreover, the addition of chromium and molybdenum to nickel steel

(*Concluded in next column.*)

World Steel Output by Processes

PREDOMINANCE OF THE BASIC OPEN-HEARTH

The classification of steel-ingot output according to grades has undergone considerable changes in the course of the last quarter of a century. The tonnages of basic and acid open-hearth steel, Thomas (basic-Bessemer) steel and acid-Bessemer steel for the various producing countries are given in Table I for the years 1913, 1929, 1932 and 1935, which has been taken from "Stahl und Eisen." The difficulties of collecting the statistics in detail account for the comparatively long interval before figures relating to a given year are available. The figures show the marked increase in the output of open-hearth steel and electric steel, while the other grades of steel have lost ground. In addition, crucible steel output has diminished from 242,000 tons in 1913 to 21,000 tons in 1935.

In 1913, 61.3 per cent. of the world's steel output was open-hearth steel, while by 1935 the proportion had advanced to 76.4 per cent. During the same period, the production of Thomas steel had declined from 22.8 per cent. to 16.2 per cent. and that of acid-Bessemer steel from 16.00 to 4.6 per cent. On the other hand, electric steel output has advanced from 0.2 per cent. of world production to 2.8 per cent. in 1935. Open-hearth steel made rapid progress, particularly in countries with new steel industries, for while in Europe its advance from 1913 to 1935 was only from 55.5 to 65.5 per cent., in America it increased its share of total production from 68.7 to 90.3 per cent., and in Asia from 82.7 to 95.9 per cent. The basic process has been responsible for the whole of the increase, for from 1913 the acid process has progressively receded. In the United Kingdom, the acid process accounted for nearly 50 per cent. of the ingot output in 1913 but for only 19.3 per cent. in 1935. In Sweden, the recession was from 31.7 to 22.6 per cent. over the same period. In the United States a part of the basic open-hearth steel is made by the duplex process (Bessemer converter and basic open-hearth furnace), while in India the bulk of the output is produced by this process.

The advance of the basic open-hearth process has much more than balanced the drop in basic-Bessemer, which accounted for 22.2 per cent. of the world output in 1913 and 16.2 per cent. in 1935. This process has maintained its ground in Belgian-Luxemburg and Czecho-Slovakia, and has made some headway in France as compared with 1913. The decline in the total output by this process is due principally to the fall in Germany, and up to 1935 the disappearance of the British output, although the process has been since revived in this country. The contraction in acid-Bessemer steel output has been far more pronounced, and passed from 16 per cent. in 1913 to 4.6 per cent. in 1935. Canada and Japan, which in 1913 produced a quarter of their ingots by this process, now make no acid-Bessemer steel at all. There has been marked contraction in acid-Bessemer output also in the United States and Great Britain.

The progress of the electric furnace in ingot production has been steady, particularly in Italy, Austria, Sweden and Rumania, and in lesser degree in Hungary, Czecho-Slovakia, Japan, France, Russia and Canada. This type of furnace has almost completely ousted the crucible melting process, crucible steel being now made on a small scale only in Germany, France, Sweden, the United States and Japan.

TABLE I.—*Classification of Steel-Ingot Output According to Process*, 1913, 1929, 1932 *and* 1935. (In 1,000 metric tons.)

Country.	Open-hearth steel.												Basic-Bessemer steel.				Acid-Bessemer steel.				Electric steel.			
	Basic.				Acid.				Total.															
	1913.	1929.	1932.	1935.	1913.	1929.	1932.	1935.	1913.	1929.	1932.	1935.	1913.	1929.	1932.	1935.	1913.	1929.	1932.	1935.	1913.	1929.	1932.	1935.
Germany ..	} 7,330	8,224	3,634	} 8,652	} 283	144	45	} 176	} 7,613	8,368	3,679	} 8,828	} 10,630	7,395	1,817	} 6,885	} 155	—	—	} —	} 89	131	72	} 265
Saar		529	—			—	—			529	376			1,642	1,078			—	—			15	9	
Luxemburg ..		23	2	7		—	—	—		23	2	7		2,670	1,950	1,822		—	—	—		—	—	—
France ..	—	2,731	1,627	1,940	—	22	12	26	1,583	2,753	1,639	1,966	2,806	6,680	3,786	4,004	253	99	55	46	21	151	154	246
Belgium ..	—	—	—	—	—	—	—	—	213	400	295	255	2,192	3,595	2,447	2,700	—	—	—	—	—	14	9	10
Great Britain	2,288	6,584	3,967	7,452	3,872	2,442	1,114	1,905	6,160	9,026	5,081	9,357	561	—	—	—	1,066	536	113	446	—	58	33	75
Spain ..	—	—	421	—	—	—	—	—	242	623	421	461	—	—	—	—	—	361	208	[3] 120	—	19	4	[3] 5
Italy	—	—	—	—	—	—	—	—	918	1,868	1,113	[3] 1,684	—	—	—	—	—	—	—	—	—	211	240	[3] 486
Austria ..		542	165	303		—	—	—		542	165	303		—	—	—		—	—	—		90	40	64
Czecho-Slovk.		1,710	529	987		19	12	17		1,729	541	1,004		244	104	116		—	—	—		60	22	51
Yugoslavia ..	—	—	—	—	—	—	—	—	} 2,284	98	—	—	233	—	—	—	43	—	—	—	27	—	—	—
Hungary ..		—	—	—		—	—	—		496	164	414		—	—	—		—	—	—		18	16	32
Rumania ..		—	—	—		—	—	—		146	98	181		—	—	—		—	—	—		15	9	32
Poland ..		—	—	—		—	—	—	[3]	1,328	529	916		—	—	—		—	—	—		18	14	20
Russia ..	—	—	—	—	—	—	—	—	} 3,936	[3] 4,892	5,036	10,839	} ([3] 100	([3] 120	173	244	[3] 400	[3] 500	611	990	—	[3] 40	107	447
Finland ..		—	35	—		—	—	—		24	35	45		—	—	—		—	—	—		—	—	—
Sweden ..	282	258	227	399	187	238	122	202	469	496	349	601	71	70	50	88	45	13	8	21	2	113	121	186
Norway ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—
Europe ..	—	—	—	—	—	—	—	—	23,418	33,341	19,523	36,861	16,593	22,416	11,405	15,859	1,962	1,509	895	1,623	139	957	850	1,919
U.S.A. ..	[1] 20,208	[1] 47,413	[1] 11,878	[1] 30,790	993	563	105	282	21,201	47,976	11,983	31,072	—	—	—	—	9,617	7,205	1,553	2,880	21	541	144	530
Canada ..	748	—	320	—	—	—	—	—	748	1,311	320	896	—	—	—	—	274	—	—	—	—	25	20	34
Mexico ..	—	—	58	—	—	—	—	—	20	124	58	—	—	—	—	—	—	—	—	—	—	—	—	—
America ..	—	—	—	—	—	—	—	—	21,969	49,411	12,361	31,968	—	—	—	—	9,891	7,205	1,553	2,880	21	566	164	564
Japan ..	—	—	—	—	—	—	—	—	[3] 180	2,238	2,325	4,319	—	—	—	—	[3] 60	1	1	—	—	53	70	220
China	—	—	—	—	—	—	—	—	43	30	—	—	—	—	—	—	—	—	—	—	—	—	—	—
British India	—	—	—	—	—	—	—	—	63	[1] 581	[1] 575	[1] 807	—	—	—	—	—	—	—	—	—	—	—	—
Asia	—	—	—	—	—	—	—	—	286	2,849	2,900	5,126	—	—	—	—	60	1	1	—	—	53	70	220
South Africa	—	—	—	—	—	—	—	—	—	39	43	—	—	—	—	—	—	—	—	—	—	—	—	—
Australia ..	—	—	—	—	—	—	—	—	14	390	225	575	—	—	—	—	—	—	—	—	—	—	—	—
World ..	—	—	—	—	—	—	—	—	45,687	86,030	35,052	74,530	16,593	22,416	11,405	15,859	11,913	8,715	2,449	4,503	160	1,576	1,084	2,703

[1] Share of duplex process in ingot output: (*a*) U.S.A., 1913, 2,246; 1929, 3,008; 1932, 293; 1935, 975. (*b*) British India: 1929, 324·5; 1932, 376·6; 1935, 525·2.
[3] Estimated.
[3] Estimated on output up to September.

(*Concluded from previous column.*)

further reduces the critical cooling rate, so that a quench in air can be substituted.

Another point of equal importance is the fact that nickel lowers the transformation points, this being especially marked on cooling, thus rendering heat-treatment less hurried and therefore more fool-proof.

MR. HERBERT GEORGE JENKINSON, a departmental manager of Industrial Steels, Limited, Sheffield, died on Christmas Eve as the result of a motor accident. He was 62 years of age. Mr. Jenkinson had been connected with the firms of Jonas & Colver, Limited, and Industrial Steels, Limited, for 45 years or more. He had been with Industrial Steels, Limited, since 1921, when that company was formed to take over part of the Jonas & Colver works, and he was in charge of the testing and heat-treatment of steel for them.

Production of Some Intricately-Cored Iron Castings

A number of practical points were educed from Mr. Harris's Paper on "The Production of Some Intricately-Cored Iron Castings," read before the Lancashire Branch of the Institute of British Foundrymen, and reproduced in the JOURNAL for December 23 last.

Following the usual custom, a vote of thanks was accorded to the lecturer. It was proposed by MR. H. V. GRUNDY, who expressed the opinion that the Paper was novel in that it dealt with certain specific castings rather than general foundry practice. The lecturer had gone into great detail in describing the manner in which the patterns and moulds were made, but the slides were deficient in dimensional description, and he would be glad if Mr. Harris would give some further information regarding this point. The first casting shown was 13½ in. in diameter and weighed about 8 cwts. What were the other sizes and thicknesses which were being dealt with?

He would like to congratulate the speaker upon the excellence of his Paper, and upon winning the competition organised by the Lancashire Branch. The competition had been open to all, and it was a credit to Mr. Harris that he should be declared the winner, particularly in view of the fact that he came from such a distant part of the country, where personal foundry contacts were very infrequent, and in consequence it was so difficult to exchange ideas.

Mr. Grundy also expressed the thanks of the Institute to Mr. Jones, whose interest in the Institute and whose generosity had made this competition possible. Mr. Harris was making his *début* before them, and no doubt he would become one of the Institute's future lecturers. This had been made possible by Mr. Jones, and he would like him to accept their appreciation of his efforts.

MR. A. L. KEY seconded the vote of thanks and associated himself with the remarks Mr. Grundy had made. The vote was carried with acclamation.

MR. HARRIS, responding to the vote of thanks, expressed his appreciation of the way in which he had been welcomed by the members of the Lancashire Branch. Referring to Mr. Grundy's question as to the size of the casting used, the 13½ in. referred to the diameter of the cylinder bore (Fig. 1). The core of the casing was 1 in. wide and 11 in. deep, and all other dimensions were to scale. Mr. Harris then explained further points by means of slide illustrations.

Steel-Mix Changes

MR. GRUNDY asked for further information upon the steel mix which the lecturer had evolved. He would also like to know whether Mr. Harris had found it necessary to have recourse to chills in dealing with the varying thicknesses, or what method had been adopted to overcome this tendency of the metal to "draw." They all knew that this differed in regard to the steel mix. He also noted Mr. Harris' reference to the "necessity to ram cores less heavily," and would like to know if he used semi-solid core oil on all the cores in that particular job. Was it not possible to use more efficiently a liquid oil?

MR. HARRIS explained that the steel mix consisted of about 25 per cent. mild-steel scrap, 35 per cent. cast-iron scrap and 40 per cent. pig-iron with low-phosphorus content. He was not responsible for the original oil-sand mixture, and although he had been in charge of the foundry for some time, he had not had occasion to alter the mix; but he would ascertain if a thinner oil could be used with some of the cores.

Body Core Making

MR. GRUNDY pointed out that with the liquid core oils there was practically no necessity to ram in regard to some of the less intricate cores —the body core, for instance. He noted Mr. Harris' reply to his question referring to the semi steel, but asked for details of the analysis, and what ultimate analysis of the metal was aimed at.

MR. HARRIS said that the body core was not made with the semi-solid core oil, but with a thinner oil. The jacket cores would be made of a semi-solid in order to get green-bond to stand up for drying. The bottom part, the little pods would be made of a more naturally bonded sand in order to withstand erosion and drying. If the small pods were made of the same sand as the bulk of the core, during the drying they would probably all crumble up. He could not say very much about analysis, as it was only recently that a chemical control had been installed in the laboratory of the works with which he was associated. The carbon content would be about 3.2 per cent. In reply to a further question by Mr. Grundy, Mr. Harris stated that his firm did not use any chills now.

Casting Temperature

MR. F. ANDREWS (Manchester) asked at what temperature the metal was poured.

MR. HARRIS replied that his firm used an optical pyrometer, and he found that everybody's opinion was not identical with regard to temperatures. Above a certain temperature they seemed to vary 50 deg. up or down. The pyrometer was used more for day to day comparison, and they tried to get it as near 1,320 deg. C. as possible. Whether this was correct as applied to anyone else's method he could not say, but as a method of comparison it was satisfactory.

Oil to Sand Ratios

MR. KEY raised a point with regard to oil-sand mixtures. During the past few years he had experienced difficulties in making awkward cores in oil sand. A fundamental point to consider was the proportion of oil used to the amount of sand. What proportion of sand to oil was used by Mr. Harris in respect to jacket cores, and what was the proportion of sand to oil in respect to casing cores and the larger cores such as those used for valves?

MR. HARRIS said he had not the information available at the moment but he would probably be able to supply it later.

MR. KEY said that it might be interesting for the members to learn that, to achieve success with a certain type of core, it was necessary to use 70 parts of sand to one part of oil. If there was more oil the job would be unsuccessful. Fifty parts of sand to one part of oil was the strength necessary for certain other cores. Another point was that he assumed Mr. Harris used all wrought irons for his jacket cores.

Ensuring Equal Section Thickness

MR. HARRIS having agreed that this was so, MR. KEY continued by inquiring whether the lecturer had ever sectioned a casting to determine whether a core was expanding unequally or otherwise. He had had considerable experience with jacket cores, say, 1¼ in. thick, 3 ft. dia., and 6 ft. long. Cast-iron rings were placed in them, although they were only 1¼ in. thick. All the rest was wrought iron. This had to be done because, down the front of the core, there was left more or less of a broken circle. If they had had wrought irons in those jobs they would have had the jacket core through on the outside of the mould. Cast iron was used to obviate this tendency.

Dimensional Changes and Their Cure

MR. HARRIS said he had not noticed any such difficulty on casting, but he had on drying. Care had to be exercised in order to keep the cores from distorting. The necessary correction was made by making the core box "wrong" in order to get the job "right."

MR. KEY said he would not be surprised if there was found to be a difference in section.

MR. HARRIS admitted that there would probably be a difference of $\frac{1}{16}$ in. in thickness on one side, compared with the other.

MR. J. MASTERS asked whether it was not possible that in drying the core the core plate expanded when it went into the stove and pulled the core with it. MR. HARRIS agreed that this was so.

MR. MASTERS suggested that there was a larger expansion on the aluminium core plates than there was with the core. He further explained that if the core plate had been made in cast iron it would not have taken the expansion so quickly. The expansion could also have been negatived by piercing the core plate in various places. A firm in the Manchester district had hundreds of dryers, all of which were perforated, and their cores had to be within a few thousandths of an inch of the truth, or otherwise they were discarded. Every mould was tried every day, and a minimum of about 150 moulds was cast daily. If a core were a couple of thousandths out of truth it was discarded.

MR. HARRIS said he would look into the point, and ascertain whether it was advisable to have a cast-iron dryer, instead of an aluminium one, and perforate it.

MR. KEY said it was a simple matter of trial and error, with regard to the dryers or the jigs, to keep the core exactly to shape. The point was that in bending wires in building up a jacket core two men could make cores which would act entirely differently when the metal got round them. It was merely a question of camber.

MR. F. ANDREW said he had noticed that with pipe cores made on barrels without hay band, if the runner played on the one side of the core, this had the effect of expanding one side of the barrel and pulling the core out of centre.

Gas Evolution

MR. S. G. HARRISON remarked that the author had stated that, owing to the very thin section of the job, the casting had been effected at a very high temperature, but that, in future, the temperature would be lowered. The speaker was of the opinion that the high temperature would be better practice, as at a low temperature any gases generated would not have an opportunity to escape before the metal set. Had Mr. Harris experienced any trouble with the metal getting into the vent over the jacket core where a little ring of loam was used? Personally, he would have been inclined to ram a tube into the core and then carry it through the top part of the mould, which would eliminate any danger.

MR. HARRIS admitted that he referred to the use of lower temperature and getting the gases away, but he qualified it subsequently by stating that pencil runners were used which gave a slow filling in the mould. This afforded the gases a chance to escape as the mould was filling. To use pencil runners it was necessary to use very hot metal. Sometimes with very small cores they did bring tubes up, but not through the top. He brought the little ring of loam up more than was really necessary, and as the top came down it sealed the vent.

MR. MASTERS stated that there was a "ricket" scratched round the vent. The pressure of the top part sealed the vent. The moulds were too hot to bear the hands upon when assembled, and the heat dried the loam and oil.

(Continued on next page.)

This Fluidity*

By J. H. PEARCE

The fluidity of liquid metals is a subject which, of late, has been much discussed, and whilst it is not possible in a short Paper to enter fully into this, it is proposed to cover a few points, as the subject is of very great importance to the foundryman. This property of fluidity, which has been more comprehensively described as "flowing power," "runnability," "castability," "life," etc., is dependent on the state of the liquid metal itself, the requisite degree of it varying with the length of time occupied in pouring, the weight and shape of the castings, and the number of moulds to be cast in each individual heat.

However, it must be admitted that up to the present time there has been no really accurate method of measuring fluidity, and it has rested largely on the skill and experience of the men responsible for the metal. If, in addition to this, one had a reliable method of measuring fluidity—that is, a quantitative method which could be used from one heat to another in order that the fluidity of a particular heat could be compared with that of another under the same conditions—then the foundryman would be able to control his metal with a far greater degree of accuracy, and could repeat heats with absolute similarity. Thus a big step would have been taken in the improvement of castings as a whole.

Various methods of measurement have been tried, and experimental work is still being carried out, but none has yet achieved quite a hundred per cent. success as a practical, everyday proposition. The spiral test-mould gives some promise, particularly with cast iron, but some difficulty arises with steel. In this method a sample of metal is taken and allowed to run into a small mould. This mould contains a spiral-shaped groove, and the length of the spiral when cast gives some indication of the apparent fluidity. Another method of promise is that of the Ruff (R.U.F.F.) test-mould, which consists of a mould containing a straight-lined groove, the fluidity of the metal being again compared by the length of the groove cast. The chief difficulties arising with these methods are in pouring constant weights of metal, and obtaining constant pressures. However, it is hoped that these difficulties will soon be overcome.

It is in making steel castings that the property of fluidity becomes so desirable. Owing to the relatively high melting point of steel, and its shorter pouring range, it is necessary to use all possible means of improving it, without, at the same time, robbing the steel of those properties essential to good castings. To accomplish this, it is necessary to know something of the main factors which influence fluidity, these chiefly being (1) chemical composition; (2) temperature, and (3) method of manufacture.

Composition

It is, of course, well known that certain elements assist fluidity, whilst others retard it; but as a customer usually orders his castings to specific tests which involve a definite composition, the foundryman cannot help himself to any great extent from this particular angle. He should, however, include in his specification as much of those fluidity-promoting elements such as carbon and manganese as possible, varying the heat-treatment of the castings to give the necessary physical tests.

Temperature

It is generally understood that the hotter a liquid metal becomes, the greater the degree of fluidity it possesses. However, the higher the casting temperature, the greater is the risk of damage to the mould, and consequent troubles with the castings, such as scabs, cracks, blowholes, etc. Fluidity, therefore, must *not* be obtained at the expense of high temperature.

It is an occasional grievance of the steelfounder that heats of similar composition differ greatly in their running properties. Certain heats, whilst appearing hot, run sluggishly, whereas others appear cooler but run much more freely and have a longer life in the ladle. What, then, causes this difference in fluidity? Apparently it is not temperature, and must, therefore, be some variant in the method of manufacture.

Influence of Process

There have been many discussions on the best method of making steel for steel castings. Some prefer the converter, others the open-hearth, and some the electric process, but from the point of view of fluidity, it is generally acknowledged that they are in this order of excellence. What common property do they also possess in this order? It is that of their *degree of oxidation*. The converter with its violent reaction with atmospheric oxygen, the open-hearth with its long boil with iron ore, and the electric process with a shorter boil, follow out this same order. It is suggested, therefore, that a good oxidation during the procedure of any of these processes is essential if a gain in fluidity is to be obtanied. This gain may be partly due to the chemical reaction, and also due to the mechanical turbulence of the passage of the gases through the metal, so that the intensity of the oxidation, as well as its duration, is important.

If, however, the oxide content of the liquid metal is not well controlled, difficulties will undoubtedly arise with that other primary factor affecting the fluidity of steel, namely, deoxidation. The three most common elements in use for this purpose are manganese, silicon and aluminium. Manganese and silicon can be used in a variety of ways, and the manner in which they are added to the steel will have a varying effect on its flowing power. The stiffening effect of aluminium is also well known, and this element must be kept to a minimum to obtain the best results.

The products of these deoxidisers should also have consideration, as the various types of inclusions produced affect the ultimate fluidity. It will be seen, therefore, that there is a large field for experiment in the deoxidation of steel, and this work will assist the foundryman in his search for fluidity.

With the ever-growing use of green-sand moulding, with its consequent chilling effect, and the increasing demand for more intricate castings, it becomes more and more essential for the foundryman to apply fluidity to a greater degree. By adequately designing the runners and ingates, and by well venting the moulds, he can assist the metal to fill the moulds as quickly and quietly as possible. He is thereby giving his furnace operators every assistance to produce metal having a minimum of temperature with a maximum of fluidity, at the same time ensuring it is put to the best possible use in the successful production of castings.

DISCUSSION

MR. J. ROXBURGH agreed that the question of fluidity was of very great importance in the foundry, particularly in the steel foundry. Moreover, even in the iron foundry it was sometimes found that, although the metal had been melted under what might be called ideal conditions, and appeared to be sufficiently hot, as soon as the casting was machined, one might find on the surface a series of holes. The author had mentioned blowholes due to temperature, but more often, if a job were cast at a low temperature, gas holes were found, and this was often evidence that the metal was not cast at a sufficiently high temperature. The conditions of melting were very important. Sometimes the conditions in a cupola varied occasionally, and although the iron might seem suitable at the time, after a casting had been machined it might be discovered that it was unsuitable. In the iron foundry, as in the steel foundry, the composition of the metal had an effect on the fluidity. For instance, with a low-carbon iron it required more super-heating than an ordinary iron, because the initial freezing point was much higher, and therefore the iron appeared to lack life.

MR. PEARCE said that, in speaking of blowholes due to temperature, he was, of course, referring to steel. He could not understand blowholes due to low temperature with the cast iron.

(*Continued from previous page.*)

MR. HARRIS stated that the top box was quite hot and dried itself. It went down and made a seal.

Standardised Runners

MR. R. TURNER asked for information concerning the size of the down runners. Were the in-gates bigger than the down runners or the down runners bigger than the in-gates?

MR. HARRIS replied that he was not responsible for the designs and could not answer the question straightaway. The patterns were got out and the runners were standardised and made a part of the pattern. It was necessary to emphasise the importance of good patternmaking for this class of work. An effort should be made to produce coreboxes as accurately as possible, in order to save the moulder the trouble of having to rub his cores.

MR. TURNER asked whether the runners entered from underneath or direct into the body.

MR. HARRIS replied that the runners went into the body. There was a well at the bottom.

MR. J. R. PLATT observed that no doubt Mr. Harris had experienced the difficulty of keeping up the metal level in the runner box due to vortex immediately over the down-gates. Had he ever used anything in the nature of a square runner instead of a round one, in order to obviate this vortex?

MR. HARRIS said that the down-gates used on a number of jobs in the foundry at Camborne were rectangular, with a stopper on top.

MR. R. A. MILES asked what was the type of studs referred to in the Paper.

MR. HARRIS said that they were tinned, and that they were merely used under the bottom of the cylinder core.

* This Paper received the President's second prize in a Short Paper Competition organised by the Sheffield Branch of the Institute of British Foundrymen.

Casting of High-Alloy Cast Iron Rolls

Writing in "Liteinoe Delo," No. 7, 1937, V. S. KRASOVITSKY, B. B. EZERSKY and VILYANSKY describe some experimental investigations into the casting of high-alloy cast iron rolls for a sheet rolling mill. The composition of the metal before tapping was C, 3.23; Si, 1.15; Mn, 0.88; S, 0.048; P, 0.229; Cr, 1.21, and Ni, about 4 per cent. Samples were taken at each stage in the melting process (after making the various additions of ferro-chromium, ferro-silicon and ferro-manganese).

The results emphasise the difficulty of casting such rolls to obtain the required degree of hardness of the chill. As far as possible, the original charge should be so proportioned that the first sample poured after melting already approximates to the desired composition, any additions to the bath being cut down to the absolute minimum. The ladle should be strongly pre-heated and the metal run out of it as soon as possible. No difference was observed in the results of the preliminary laboratory tests (metallographical investigation and chemical analysis) and machining tests on the annealed and unannealed rolls.

Institute of British Foundrymen

SCOTTISH BRANCH ANNUAL DINNER

The annual dinner of the Scottish Branch of the Institute of British Foundrymen was held in the Grosvenor Restaurant, Glasgow. Mr. Evan G. Ross (Branch-President) occupied the chair, and was supported at the high table by Sir John Stewart (Lord Provost of the City); Mr. C. W. Bigg (President of the Institute); Prof. A. L. Mellanby, D.Sc.; Dr. William S. Cormack (Principal of the Stow College of Engineering); Mr. P. M. Ritchie (President of the West of Scotland Iron and Steel Institute); Mr. Victor Stobie, M.I.E.E. (Past-President of the Institute); Mr. T. Makemson (General Secretary), and representatives of other institutions.

City of Glasgow

MR. VICTOR STOBIE, proposing the toast of the "City and Corporation of Glasgow," said this great city had been made great by the laudable ambition and irrepressible energy of its citizens. In proposing such a toast one could easily run into danger, especially by admiring things outside its boundaries. One admired and was charmed by the cordiality of the citizens of Glasgow and their democratic and human outlook. The city welcomed visitors somewhat coldly at first, but with great warmth after they knew one better. Glasgow was famed for the hospitality which it extended to its guests in its Municipal Home, its homes of learning and its private homes. It was by that little touch of slightly cold reception at first that made the citizens of Glasgow so charming. He admired the sagacity of the Glasgow people and their great courage in staging a great exhibition. He noticed that the symbol of that venture was the Tartan Lion, but for this occasion its claws were turned inwards. They knew of the troubles with other exhibitions, but they had the courage and relied upon themselves. He wished them every success. The Art Galleries, a permanent memento of previous exhibitions in the city, was a prize masterpiece.

Very fortunate was the city which had for its Lord Provost Sir John Stewart, whose enthusiasm for the human weal was so pronounced. In electing him as the chief magistrate they had chosen a man who would undoubtedly lead them where the heart of Glasgow wanted to go.

Glasgow Exhibition

THE LORD PROVOST (Sir John Stewart), in responding to the toast, thanked Mr. Stobie for the very kind manner in which he had proposed it, and his appreciation of the efforts of the Corporation for the betterment of the conditions of the citizens of the city. The toast was the City and Corporation. Glasgow as a city owed much to the men who made it by their energy and great foresight. History tells of the Clyde as a stream which, 150 years ago, could be waded across. It was also said that the Clyde made Glasgow, but it was really the men who had the foresight to widen the river who made the city. At the present time the Clyde could take the biggest ship in the world. They thought that Glasgow was a well-managed city, but they always had their critics; that was just as well, as intelligent criticism kept them up to the mark. He considered that the first business of the municipality was the health of the citizen. If the citizens were not healthy it was a very expensive matter dealing with them, and he thought it much better to keep them in health by the expenditure of the same amount of money. He was happy to say that, since he had assumed office, trade in Glasgow had improved, and in many cases improved materially. The foundry industry was one of the most important, and the Institute of British Foundrymen was doing excellent work on behalf of the industry. It welcomed both employer and employee in its membership, and in this way did excellent work. It had done much to promote better relations and conditions in the industry.

It had to be remembered that we could not continue as the workshop of the world because other countries had progressed and were now able to provide for themselves. The Institute should take the long view, and try to envisage the evolution of the next 50 years, because if this country was to maintain supremacy it must look to the future. There were at the moment 73,000 in Glasgow without employment, and if any of those present could do something to help reduce the number he would be pleased. Mr. Stobie had referred to their Art Gallery as a priceless masterpiece; the surpluses of three former exhibitions had formed the nucleus of the Art Galleries fund, and he was looking forward to another successful exhibition next year.

The Institute

MR. P. M. RITCHIE, in proposing the Institute of British Foundrymen, said that in the course of a very long connection with the iron trade he had very happy relations with the foundry industry and had been the recipient of many kindnesses from its executives. A perusal of the literature published by the Institute showed the splendid ideals of the Institute and its members, its activities and scope. He was particularly interested to see that the seal of the Institute bore the motto "Science hand in hand with Labour." Here was a striking combination, and was it any wonder that the Institute had done so much excellent work for the industry, had been granted a Royal Charter of Incorporation and taken such a strong hold in industrial centres? It had, in a comparatively short term of existence, gathered 2,065 members, 304 of whom were in Scotland. The foundry industry was extremely fortunate in having an Institute of such magnitude and importance. It gave the fullest opportunity for the investigation and discussion of matters appertaining to the trade and the spread of knowledge. No one could fail to be impressed by the work of the Technical Committee.

It was a pleasing thing to know that they met this year under happier conditions, since shipbuilding, engineering, the foundries and steelworks had more work than they could deal with. It was never safe to prophesy the trend of trade in heavy industries, but there was every reason for hoping that the period of prosperity would last for some time longer.

Ever-Broadening Policy

MR. C. W. BIGG (President of the Institute), in replying, said it was very gratifying to him as President to learn of the increase of membership and the progress of the Branch. He was also gratified to find how much the efforts of the Institute were appreciated by the Local Authorities. That satisfaction was increased because he thought it was deserved. Mr. Ritchie was a local man with important local connections, and no matter what he knew about the national body he based his views on the activities of the Scottish Branch, and therefore the Scottish Branch's prestige of itself and the Institute. He wanted to emphasise the importance of the Branch work; he by no means wished to imply that the part was greater than the whole, but according to the traditions of the Institute of British Foundrymen they were bound to rely very largely on the Branches. He had been glad to see such signs of activity in their Branch. He could not take the time necessary to review all the achievements of 34 years for the benefit of the industry, but they had been many and far reaching. The Proceedings which were published were valuable, but not the most important contribution of the Institute to industry; that lay in the meetings for the reading and discussion of Papers. The members had a record of which they might well be proud. Mr. Ross, in his recent Presidential address, had referred to the enthusiasm of the members and his pride in the Scottish Branch. He himself, as President of the Institute, was very proud of the enthusiasm shown by the members, because the Institute was a voluntary body, and the ordinary members travelled to attend the Branch meetings and council meetings, others gave time and travelled long distances to attend the General Council and committee meetings. It was a great thing to get a large body of men with such enthusiasm for their work. The meetings allowed them to transmute the heat of their arguments into good fellowship, and in passing he wished to say that during his membership he had made many excellent friendships which he hoped to keep.

As to the future, Mr. Bigg thought it certain that there would be much greater changes than in the past, and it was not sufficient for their progress to keep pace with changes; it must move in advance of them. The progress of the Institute had been great, but its policy must be broadened to deal with future events. Mr. Bigg then quoted the following passage from Mr. Ross's Presidential Address: "There are some prominent firms associated with the industry to whom the Institute is very much indebted. On the other hand, there are many firms, either owning foundries, or buying castings from outside foundries, who do not appear to realise the benefits which they derive from the existence of the Institute. The time is now ripe for a determined effort to bring all the foundries and engineering firms not attached to the Institute into its membership. This could be done by bringing to their notice the advantages that they directly and indirectly receive through the work of the Institute."

Trade in general received great assistance from the Institute, but it did not get the support in return. He did not say that the firms were wrong, but they would have to convince them of the value of the Institute's work. They had not to look back for many years when industry was constituted by the craftsman; he was still very important, but the changes which had taken place demanded things which the craftsman could not provide. In general principles, the Institute must adapt itself to meet the changing conditions. The changes might be disturbing, but they would approach them with minds open and a will to analyse them. The Branch work not only affected but controlled the work of the Institute, and indirectly active Branch members could have an important influence.

Unique Educational Facilities

MR. T. MAKEMSON, in proposing the toast of "Technical and Educational Institutions," said education in Scotland was a tradition, sought for not only for its help in earning a living but for its own sake. Technical education was well represented by the University and the Royal Technical College, whose students were to be found everywhere. There was, however, another aspect of education, namely, for the artisan. In this direction Glasgow was again to the fore. The Stow College was conducted for the training of apprentices in the engineering trades as distinct from the purely technical aspect. He often wondered whether the works made the most of their apprentices. Many firms had excellent apprentice-training schemes and he hoped they got an adequate return. There were, however, many firms who did not attempt to help or encourage apprentices. In many factories boys were made to perform only menial work for a long time, because the foundry manager had to do it in his youth; the boys did not always get a fair deal. In regard to technical societies the members of such bodies in Glasgow must be very assiduous and busy if they took full advantage of the facilities. He noticed from the joint syllabus that there were 28 engineering technical societies, and 10 chemical societies, and membership of any one of them permitted attendance at the meetings of all of

them. It seemed to him the best solution of what for long had been a difficult problem. It was often said that there are too many societies, but was it true? They had all come into being to meet a definite need, the need to get together and listen to Papers and discuss matters pertaining to the industry.

Professor Mellanby, with whose name he coupled the toast, represented within himself both sides of the toast. He occupied for many years the Chair of Engineering at the Royal Technical College, and was a Vice-President of the Institution of Engineers & Shipbuilders. A glance down the list of Past-Presidents of that Institution was an epitome of the progress of shipbuilding and engineering. He did not know whether being a Vice-President meant, as in some societies, that in due course Professor Mellanby would go to the Presidency, but if he did he would add lustre to an already illustrious list. He thought the toast was a very fitting one to be honoured in a gathering of technical men anxious to help in the education of the young men.

PROFESSOR A. L. MELLANBY, D.Sc., said that he was interested to hear Mr. Makemson speak in such high praise of the Royal Technical College. His experience had been that the college was much better known everywhere than in Glasgow. He had also been very interested in the Lord Provost's remark that this country could no longer be the workshop of the world, and his injunction to look forward for the next fifty years. He had recently spent some time on the Continent and had been much impressed by the manner in which the firms took advantage of all recent discoveries and research work. This was especially the case in Germany, where he was struck by the great technical development not only in equipment but in men. Wherever he went he found the staff were well acquainted with, and could discuss, all latest research of all countries. He was particularly impressed by the manner in which the Germans were using research results and applying them to industrial processes. An instance was the use of lignite of which they had a good supply. They had made exhaustive investigations into the type of burner best suited for its combustion, and had recovered oil, gas and coke. They had developed two systems of firing by lignite and by coke. The value of research was not so much its own importance but the manner in which it was being recognised. The importance of research was its practical application to industrial processes. Unless this country paid more attention to research and made practical use of it, the day would be not far off when we would be entirely dependent on other countries. Many very important plants and processes bearing foreign names had been produced as a result of research work in this country.

The Stow College

DR. WILLIAM S. CORMACK (Principal of the Stow College of Engineering), in proposing the Scottish Branch, said the Institute was considered one of the younger institutions, but it was very effectively moulding the character of the younger generation. The fact that this country was no longer the workshop of the world had been referred to more than once, and he thought that Mr. Ross, in emphasising in his Presidential Address the necessity of educating the young men of industry, had realised that fact. The Stow College had been mentioned by previous speakers, and the Scottish Branch members were taking considerable interest in, and giving valuable assistance to, that institution. The University and the Royal Technical College were very excellent institutions, as he knew from his own experience, but they assumed that everyone was capable and anxious to take a degree. The Stow College assumed that there were many people who were very anxious to obtain all possible knowledge of their calling, but who would never take a degree. They had to assist the young lads who were entering upon their life's work as craftsmen and who would in the future still be a necessary and important factor in industry, as Mr. Bigg had mentioned. The Institute of British Foundrymen played an important part in the training of these young men in a specialised manner.

MR. EVAN J. ROSS, in replying, said that the Branch was very much honoured by the presence of their guests. It was the second year in succession that the Lord Provost had graced the dinner by his presence, and they appreciated his interest in their industry. The Branch had so far had a very interesting and successful session, although he regretted that the membership had not increased to the same extent as last year, which was an exceptional year. They had managed to pass the 300 mark, and he hoped 350 would be attained before the end of the session. The foundry industry was, in fact, the only creative industry; the engineer started with created materials, such as castings, but in the foundry all the materials used were crude and had to be converted to a form suited to the engineer's requirements. This required more and more knowledge to meet increasing demands of modern work. The more one learned, the more one knew how much there was to learn. One person could never get to know all of it, so it was necessary to hold the meetings for the exchange of ideas and information. The Branch was very well conducted owing to the excellent work of Mr. Bell, the secretary, and he hoped that the education of the foundryman might long continue to be the Scottish Branch's main objective.

During the evening the company was entertained by a musical programme.

Cleveland Blast-Furnacemen's Wages

An important agreement has just been concluded between the Cleveland Ironmasters' Association and the Blast-furnacemen's Union for the adoption of a new formula for the fixation of wage rates at the local blast furnaces. Hitherto wages at the whole of the ironworks in the North of England have been regulated by the net average selling price of No. 3 Cleveland pig-iron. The production of this grade of iron has recently dwindled almost to vanishing point, and the contention that the price of No. 3 G.M.B. was no longer a reliable index was fortified when, in October last, the "ascertainment" reflected an actual decline in selling prices. The difficulty was temporarily met by the concession of a special advance of 10 per cent. to the blast-furnacemen, and the employers and employed have since been engaged in an attempt to evolve a new basis for the wages sliding scale. The outcome of these negotiations is that basic iron will take the place of No. 3 Cleveland foundry iron in the new arrangement. The standard price in the new scale commences at 50s., with a movement of one-quarter of one per cent. on all rates for each 3d. per ton above the standard. In effect, this means an immediate advance of 6 per cent. in the scale percentage on the men's rates, raising the existing 35 per cent. to 41 per cent. The next ascertainment is due in the third week in January, and will be applied to the rates on and from the first Sunday in February, 1938, when a further advance is expected.

(Continued from next column.)

variations in beam load and hammer lift, almost any type of tappet can be tested.

Some interesting results on the improved impact strength of hardened and tempered cast iron have been obtained on this machine, after exhaustive tests on various designs of tappets. By manipulation of the load and lift on the impact machine, it has been found possible to break instantaneously a tappet in the "as-cast" condition, whilst one from the same batch and with the same chill depth which has been hardened and tempered will withstand 10,000 to 15,000 blows before fracture. Correct heat-treatment does not impair the abrasion resisting properties of the chilled face, although it is necessary to control carefully the "soaking time" during heat-treatment to avoid any breaking down of the structure.

Production of Chilled Tappet Castings*

By J. JUDD.

The proved superiority of chilled cast iron over steel for the production of automobile engine tappets has led to its standardisation by the majority of engine designers, and the manufacture of the necessary castings provides a good example of the development of specialised foundry technique.

The tappet functions as a link between the engine camshaft and the valve mechanism, and the castings must have the following essential features:—(1) A hard surface on the face of the head to resist abrasion by the cam; (2) ease of machining on the stem and at the back of the head; and (3) a high impact strength to avoid fracture during service.

These ends are achieved by producing the castings in a soft grey iron with a sharply defined chill of about ⅛ in. depth on the face of the head, and as the most popular type is the "mushroom" tappet with a head thickness of the order of ¼ in., it will be seen that close technical control is necessary for the successful production of 10,000 to 12,000 castings per day.

Moulding and Casting

The moulds are jolt-rammed in green sand, employing usually 32 or 40 patterns which are mounted in four rows of eight or ten, and small individual runners ⅜ in. long are moulded centrally on the stem of each casting. These runners connect with open horizontal runners for each row of castings, and the moulds are then mounted on machined cast-iron plates which form the faces of the castings.

Metal is melted from a hematite base mixture in a one ton per hour cupola, and is tapped into 2½ cwt. ladles, taps being taken at regular intervals to avoid any variation in total carbon content, which has been found to influence largely the depth of chill. One box is then cast from a hand ladle for fracture test, and if a satisfactory chill is shown, the first line of 10 boxes is cast up on cold plates. Subsequent control of the chill depth for the various types and sizes of castings is then made either by means of ladle additions of ferro-silicon or by variations in the temperatures of the chill plates.

The castings are then tumbled and fettled and despatched to the machine shops for grinding on the face and sides of the head, there being grinding allowance only at these points. Afterwards they are hardness tested on the chilled head to a minimum of 450 Brinell. To reject any castings having too great a chill depth, a special etching test is then given by immersing the heads of the tappets in a dilute acidic copper sulphate solution, which gives a deposition of copper on the chilled surface only and enables a visual examination of the chill depth to be made.

Impact Testing

As the usual static mechanical tests are of no great value in material control on this job, a special machine has been developed for the purpose of obtaining comparative repeated impact tests on various types of tappets. The beam carries a load of 42 lbs., and the steel hammer has a drop of 1½ in., giving an impact force of about 5 ft.-lbs., which is delivered at four points on the circumference of the tappet head at the rate of 120 blows per minute. Relative impact strength is measured by the number of blows required to fracture, these being recorded by means of a counting device attached to the machine and a special trip which automatically stops the machine when fracture occurs. Whilst this test is not intended to represent service conditions, it serves to indicate relative impact values for changes in design or material, and by means of

(Concluded in previous column.)

* Short Paper read before the Birmingham Branch of the Institute of British Foundrymen.

Steel-Mix Irons

VALUABLE DISCUSSION AT BRADFORD

MR. J. ROXBURGH, Past-President of Sheffield Branch of the Institute of British Foundrymen, addressed members of the West Riding Branch, at Bradford Technical College, last month. His subject was "The Production of Certain Iron Castings," and in the course of his remarks he reviewed his methods of manufacture of a series of castings of a varied character, large and small, and gave his reasons why he had adopted those methods. Mr. H. Forrest presided.

The author, at the outset, said he proposed to take his audience, so to speak, into the foundry to study the methods of manufacture of certain iron castings, including the practical, technical and metallurgical aspects. He hoped thereby to interest them, particularly as he was dealing essentially with foundry practice. It was of vital importance to have all the technical knowledge possible, but, at the same time, there were innumerable points on the practical side which required great thought and care, and in consideration of which, very often, experience alone was the only guide.

Mr. Roxburgh explained that his was primarily a jobbing foundry; but from time to time jobs came along requiring a certain number-off, which constituted what one could term "semi-repetition jobs." In such cases, it had been found economical, where the number justified it, to make special tackle and rigs, or devise some quick method, or at times to save part or whole of the mould or core or make them "semi-permanent." Such expense would be recovered, and larger profits and quicker delivery were possible than would have been the case had the job just proceeded as a one-off job. He was thus dealing not with repetition work on machines but work of a jobbing and semi-repetition nature.

The majority of the castings which the author described have previously been dealt with in his Exchange Paper presented to the A.F.A. Conference last year, and printed in our issue of May 20, 1937. In addition he showed examples of the use of shell patterns, tops and bottoms rammed separately, quick methods for other castings, including loam moulding, and instanced how the particular jobs had thus been cheapened. He also dealt fully with the methods of running small castings such as valve liners and bushes, where strainer and other special runners were used to ensure cleanliness. The running of the other castings, including cylinders, liners and rams, was also fully explained. In all cases the details of the method of manufacture, the runners and feeding arrangements, and the metallurgical considerations were given attention, including semi-steel mixtures, high-duty iron and cylinder irons.

Concluding his address, Mr. Roxburgh said that, when all was said and done, they were in business to make a reasonable profit, and it behoved them to lay out a job to the best advantage to that end, consistent with producing a first-class casting to meet the requirements of the customer. With the semi-repetition type of work one could lay out a job to make more profit (despite the special tackle required) than otherwise would be the case if one had only dealt with it as a one-off job. Founders must never lose sight of the fact that they had to be practical as well as technical in order to produce a first-class casting at an economic price.

DISCUSSION

Discussion on Mr. Roxburgh's address, by chance turning especially on a remark by the first speaker, developed mainly into a debate on the desirability or otherwise of using steel mixture, wrongly referred to throughout the evening as "semi-steel."

Running Cylinder Castings

MR. W. G. THORNTON (Past-President of the Branch) said that the members had listened to an interesting and practical talk, and were highly indebted to Mr. Roxburgh. The speaker was personally interested—and perhaps a little surprised—to notice that the methods employed on the class of work reviewed by the lecturer were much the same as he had himself employed when he was engaged on that class of work some twelve years ago. He noticed, however, that in the running of cylinders Mr. Roxburgh appeared to prefer to run them at the bottom. In his (Mr. Thornton's) former experience in this work they always made a point of running from the top. The cylinders ranged from a foot up to 30 ft. long and from 6 ft. dia. upwards. Of course, a good deal depended on the sand used and the conditions, but he always had in mind the danger of catching the scum and getting dirt. Mr. Roxburgh's dislike of semi-steel mixtures for certain castings was obvious, but some jobbing founders could not afford to do anything else.

MR. ROXBURGH explained that what he had stated in regard to running cylinders was that he merely ran some metal into the bottom to form a cushion for the metal from the runners, which were dropped straight down from the top. In regard to semi-steel, or steel mixture, no doubt there was something in Mr. Thornton's remark as to the economic aspect of the matter in relation to its use or otherwise, and he (the lecturer) made a great deal of jobbing work, too, but he did feel in regard to such castings as cylinders, long rams, and the like it would pay to use irons of good reliable quality, such as mottled iron and cylinder iron, along with cylinder scrap, and keep the steel addition down to 15 or 20 per cent., in accordance with requirements, or eliminate steel altogether.

MR. A. E. WORCESTER (Past-President) said he felt Mr. Roxburgh had made a good point, in regard to top running, to allow a fair space between the down runners. It gave a better chance for any scum to rise, and might, Mr. Worcester believed, help to solve some of the foundryman's problems if carefully observed.

MR. W. PARKER (Past-President) supplemented the remarks of Mr. Thornton. Mr. Thornton and himself, said Mr. Parker, had been together on this class of work years ago, and, in his opinion, the methods shown could not be improved upon. They had, however, tried to run cylinders in at the bottom, but they found they got excellent results dropping right from the top. He presumed for Mr. Roxburgh's method that they would have to use plugs of some sort in order to open the runners as required.

Limitations of Steel-Mix Irons

MR. ROXBURGH said he used balls, and lifted them out as he wanted them. For certain classes of castings, he also used top running alone with excellent results.

In answer to a query by the CHAIRMAN as to what was Mr. Roxburgh's objection to high steel-mix irons, MR. ROXBURGH said he did not wish the meeting to think he was opposed to the use of steel mix. On the contrary he used it regularly on many jobs, and had used it in all percentages up to 90 per cent., but in regard to these special jobs he had previously mentioned, they could not get away from the fact that, despite excellent cupola practice, there was always the possibility that one might not get a proper mixture with semi-steel, and also, where one required large tonnages of metal the temperature of the metal would soon go off owing to the length of time; moreover, owing to the higher initial freezing point, the "life" was not so long as with ordinary irons.

In reply to a further question of Mr. Forrest, Mr. Roxburgh said he naturally used oil sand for certain cores, but most of the cores in the jobs he had illustrated were made with ordinary core sand, with the exception, of course, of the port cores for the gas-engine cylinder which he had explained.

Steel-Mix Irons and Wasters

MR. A. W. WALKER (Past-President) asked whether the lecturer agreed that the use of steel was the cause of many foundry difficulties, such as the increase of wasters due to wrong use of the feeding rod, etc. Could not these things be done better by using all-mine irons?

MR. ROXBURGH agreed to a certain extent with Mr. Walker's observation, as he knew that extra precautions had to be taken in practice with semi-steel. There was always, he said, the possibility of troubles arising in using semi-steel mixtures unless such care was exercised. For anything like a special job he felt the extra expense involved in using a good cylinder iron, or a good refined pig, was justified, and, by using a lower percentage of steel than would have been necessary without a cylinder iron, and by admixing suitable known scraps, the cost could be reduced.

MR. F. K. NEATH (Past-President) said, in regard to Mr. Roxburgh's suggestion of lack of holding power of temperature of steel mixture in quantity, that though he recognised the value of these refined irons he believed it was possible to get a good iron of equivalent composition without necessarily being put to heavy expense. Reference had been made to the comparative cheapness factor in semi-steel mixture, but his own experience had always suggested that it was not only cheaper but acted as an improver, and was worth using from both points of view.

Where Steel-Mix Irons are Undesirable

MR. ROXBURGH said that, in producing, say, a heavy-sectioned casting, where running presented no real difficulties in obtaining a perfectly clean and sound casting, he had used up to 30 and 40 per cent. of steel without any fear. But the question of running a long ram and getting it clean was a very different matter. As a matter of fact, in order to obtain any higher tests demanded in the foundry one had to use steel in the mixture, and he himself did so regularly, but on important castings he found the life of the metal, using refined irons, seemed to be longer than with a semi-steel mixture iron, and could be melted hotter and easier.

MR. THORNTON stated that in his opinion Mr. Roxburgh was on the right lines in his mixtures for the long cylinders, though for ordinary jobbing work he was still a semi-steel advocate.

MR. ROXBURGH agreed that this was his viewpoint too, as he had explained (with certain exceptions), and he ran semi-steel mixtures daily.

MR. NEATH said that the maximum advantage in using semi-steel was the first time in running down. Was Mr. Roxburgh by his method getting these added points of carbon to give the extra and desirable fluidity?

MR. ROXBURGH agreed that the slightly higher carbon did give the extra fluidity. The disadvantage of running metal down for re-charging in the cupola was the sulphur pick-up, whereas with cylinder irons S of 0.05 was specified regularly.

MR. S. CARTER claimed he could do anything with a semi-steel that one could with a refined iron. He could not remember a single case in which he had had difficulty with a steel mixture.

MR. ROXBURGH pointed out that if one considered, however, longer rams, cylinders and heavy castings, one might encounter difficulty. There was always the risk even with these other irons, but he thought the risk was greater with the steel mixture for such special jobs.

MR. THORNTON said Mr. Carter was probably thinking of jobs of a ton or so, whereas Mr. Roxburgh was dealing with 10-ton jobs and up to 30 ft. long and more. That made a serious difference.

(*Concluded on page* 11.)

Loam Moulding of a Hydraulic Ram

By A. GREENHALGH

This job, to the loam moulder, would be quite a simple affair, but to the foundryman who has seen little or no loam moulding this description may be very helpful. The shape of the job is cylindrical, being 4 ft. in dia. by 4 ft. 6 in. deep. Fig. 1 shows the finished casting, and Fig. 2 the boards for making the mould. The necessary plates will be four—a top plate, bottom plate and two binding plates. The bottom plate is first set upon supports just clear of the floor. The spindle seating is fixed upon the plate and the spindle inserted. A layer of bricks can now be bedded in loam upon the plate, the space between the bricks being filled with ashes and trailed to a pipe leading to the outside or edge of the plate. The board for striking up the body can now be fixed on the spindle and building up continued to the first joint, shown in Fig. 3. an inch or rather more in thickness. The first grid is placed in position, the prongs of the grid resting upon the supports. The board is then fastened on the spindle. Bricks are bedded in the loam between the prongs of the grid, cinders being placed between the bricks as the building up is continued.

Fig. 5 shows the position of the grid and core so far built. It will be perceived that the prongs of the bottom half of the grid are down with three staples up for lifting purposes. The top grid is shown in position on the same sketch. After the top grid has been placed in position bricking up is continued to the top, with ashes inserted between every layer of bricks. Upon the prongs that go to the top of the print, packing is placed so that there can be a metal to metal seating in the print. After the core

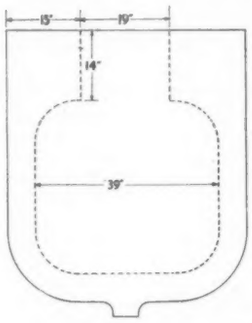


FIG. 1

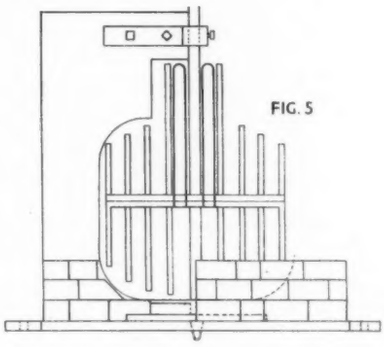


FIG. 5

FIG. 2

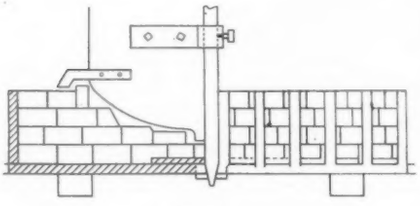


FIG. 3

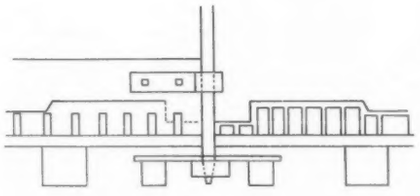


FIG. 4

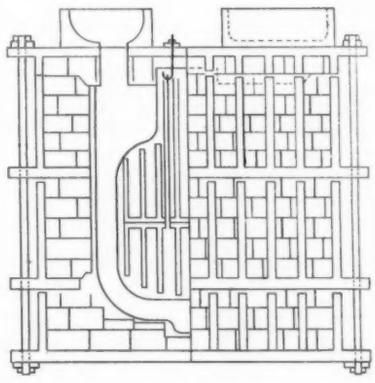


FIG. 6

The necessity for a joint here will be seen later, when the mould is being closed. The ring plate is bedded upon loam and the bricking up continued to the top joint. After stiffening for a time, the mould is slipped up with soft loam. The board can now be taken off the parts divided and put in the stove.

The top plate is flat with the exception of the joint and print for the body core, so by looking at Fig. 4 the procedure should be easy to follow.

Making the Core

This is made base downwards as the print end is too narrow in comparison with the body of the core. A seating is first made to form the base of the core. This must be dried, and when this has been done, parting sand is placed over it. Three or four supports for the core iron are now set upon the face of the odd side—about 1 in. in thickness. A layer of loam is now spread over, has stiffened, it is slipped up and is ready for the stove. After being dried, the mould and core are given a good coat of blacking.

Assembling the Mould

The bottom plate is set upon the floor, but better in a pit if there be such. This having been done, a piece of timber, which is the same thickness as the metal round the base, is placed upon the bottom of the mould. Upon this wood or packing is seated the core in the centre of the mould and square with the base. The outside of the mould is now placed in position and the print of the core again tried for "centre." The core should be standing above the joint of the mould just high enough for the top to touch it when tried on, which can now be done, bolts having first been hooked into the staples in the core; these bolts will go through the top plate. The top having been put on for the last time, the core is made secure to the top plate. The outside and top are now all lifted together so that the core can be tried for concentricity. Any slight adjustment that may be necessary can very often be done by tightening one or other of the hook-bolts. The mould, again closed, is now bolted together, the runner and riser made up and the mould is ready for casting. It will be noticed that the job is run on top, but it could be just as well run at the bottom, making suitable holes in the plates for down-runners. A large-sized riser is required for feeding purposes. Fig. 6 shows the mould closed and ready for casting.

Steel-Mix Irons

(*Concluded from page* 10.)

Casting a Large Anvil

MR. E. FLOWER (Past-President of the Lancashire Branch), reverting to the actual subject of the address, said he noted that Mr. Roxburgh cast the liners at a high temperature. He would like to know if Mr. Roxburgh's metal was pyrometer-controlled, and, if so, whether he could give an idea of the temperature at which he cast. Mr. Roxburgh had spoken of an anvil block which had required ten to twelve hours' feeding. Some twenty-five years ago, the speaker recalled making one which did not require any feeding at all. It was practically one solid piece of iron, weighed about 35 tons when completed, and was run with about 20 tons of molten metal. They got over the feeding by partially filling with pig-iron. In regard to semi-steel, he was personally a great believer in it. He thought perhaps the meeting was losing sight of the fact that the introduction of semi-steel mixture was not so much to bring the metal up to the standard of all-mine irons, as to try to improve the common iron, and he claimed from personal experience that the addition of steel did improve the common iron, providing the cupola practice was properly controlled.

Modern Methods

MR. ROXBURGH, replying to Mr. Flower, said in reference to anvil blocks that to-day the method of 25 years ago which Mr. Flower had mentioned would not be allowed. Without feeding it might result, too, in a big cavity which might not be evident. In answer to the question of casting temperature of liners, he tapped the metal at the spout at approximately 1,390 deg. C. and cast around 1,300 deg. C. if possible. The aim was to melt at as high a temperature as possible and for high-class engineering castings to cast as hot as possible consistent with all conditions being taken into consideration. He would like the meeting definitely to understand that, in general practice, he used any amount of semi-steel himself, but with certain special castings such as he had described that evening he considered it well worth going to the expense of certain types of refined irons.

On the motion of MR. PARKER, seconded by MR. CARTER, Mr Roxburgh was heartily thanked for his lecture.

MR. ROXBURGH suitably replied.

Gating System for Malleable Iron

The casting of small parts in malleable iron requires a different treatment from that of grey iron, and this applies particularly to the gating system. The various considerations which have to be borne in mind in the design of the gating system, such as the effect of the cross-section of the downgates, runners and ingates are discussed, and the results of applying the deductions to practical conditions are given in an article by Y. S. Bezmenov in "Liteinoe Delo." The best shape of cross-section for downgates and runners is the trapezoidal form with rounded corners. Particular attention should also be paid to the design of the auxiliary risers, the most suitable shape of which is that of a truncated cone or pyramid with rounded top. Such a shape is found to assist the slow cooling of the metal.

Vitreous Enamellers' Joint Meeting with Glass Technologists

A joint meeting of the Institute of Vitreous Enamellers (Southern Section) and the Society of Glass Technology was held in the lecture theatre at the Science Museum, London, S.W.7, on December 1, 1937. Mr. V. C. Faulkner (Chairman of the Southern Section of The Institute of Vitreous Enamellers) presided.

Two Papers, one on "The Decoration of Milk Bottles Using Vitreous Enamels," by Mr. H. L. Crook, and the second on "Optical Aids to the Enamelling Industry," by Mr. A. H. Willoughby, were presented to the meeting. These Papers are printed elsewhere in this issue. Mr. Crook exhibited a number of bottles and other glass containers, decorated by vitreous enamelling, used for marketing milk, beer, cod-liver oil, shaving cream, etc.

Following the presentation of the Papers, the CHAIRMAN (Mr. V. C. Faulkner) said that he knew of only one vitreous enamelling works in Great Britain which had installed an electric furnace for the enamelling process. It was of particular interest, therefore, to note that for the allied process of enamelling on glass an electric furnace had been installed and was operating on an economic basis at Mr. Crook's works.

The Paper by Mr. Willoughby had illustrated very forcibly the great progress made in microscopy during the last twenty years or so. Mr. Faulkner recalled that, when at the University, he had not had the advantage even of photomicrographic apparatus, and he and his fellow-students had had to draw exactly what they had seen through the microscope. The result was, of course, that all that they had seen had been impressed upon their minds; but the work was very tedious, and he envied the modern student who was aided by photography.

He asked whether Mr. Crook prepared his own enamels in a mill for application to glassware, or whether the enamels were applied by means of transfers.

DISCUSSION ON MR. CROOK'S PAPER

MR. J. T. GRAY said he had always been under the impression that the term "lehr" was applied only to the furnaces used for annealing glassware. Some years ago he had had some experience in connection with the design and construction of continuous conveyor-type lehrs which were direct fired by town's gas, and he had no trouble due to the products of combustion. Presumably, when Mr. Crook referred to the detrimental effects of the products of combustion, he had meant that they were detrimental to the enamel or transfers rather than to the glass; of course, all vitreous enamels were affected to some degree by the presence of the products of combustion.

He was under the impression that Mr. Crook had stated that slow heating was detrimental to the enamel or transfers used, and if this were correct, he (the speaker) would be pleased to have a further explanation of this point, as the conveyor lehrs illustrated were of the usual type and were provided with preheating, firing and cooling zones which, of course, resulted in slow heating.

Enamellers appreciated that the electric furnace gave better results than fuel type furnaces from an enamelling point of view, but so far it had been the experience that the increased cost of using electricity was out of proportion to the advantages offered.

MR. A. L. MARDEN, commenting on the statement that the enamels used on glass were of very low melting point, said that usually it would follow that their thermal expansion would be very low as compared with that of the glass to which they were applied. He asked whether there was any danger of the enamels shelling off as the result of the difference in the thermal expansions of the two materials.

Recalling Mr. Willoughby's reference to the distribution of bubbles in the ground coat of enamel on metals, he asked what was the real technical significance of the occurrence of those bubbles.

MR. E. CHIFFEY asked at what temperature the enamels were fired on glass.

MR. E. VENIS, referring to the enamelling of bottles at a temperature of 600 deg. C., mentioned by Mr. Crook, said it meant raising the temperature of the glass almost to its softening point, and he asked what difficulties arose when enamelling on a lead crystal glass, which had a relatively low softening-point, and would this necessitate fundamental alterations in the constitution of the enamels.

MR. A. G. READ asked whether it was possible to deposit sufficient enamel on the bottles by the transfer method, to withstand the attack of alkali, such as soda in hot water, during the washing of the bottles.

The CHAIRMAN asked why enamel could be applied to glass at very much lower temperatures than were necessary to apply enamel to metals.

Author's Reply

MR. CROOK, replying to the discussion on his Paper, said that most of the questions put to him had referred to the enamels; but his Paper had dealt rather with the firing of them than with the enamels themselves. The temperature at which the enamels were fired on glass was about 600 deg. C., which was very much lower than the temperatures applied in enamelling generally. The furnaces used for enamelling on glass could be made of cast iron and steel, whereas refractories had to be used in furnaces in which higher temperatures were attained.

The enamels were of fusible lead borate and were received at the works in the form of prepared glazes; they were already fritted before they were received at the works, and were usually quenched in cold water and ground.

In reply to Mr. Gray, he said it was the custom generally in the glass industry to extend the application of the word "lehrs" to continuous decorating furnaces in addition to annealing furnaces. When he had referred to the products of combustion, where gas was used as the heating medium, having a detrimental effect, he had meant that they were detrimental to the enamels, not to the glassware. He had not stated that slow heating was detrimental, but that it was desirable.

He had not noticed any particular brittleness in enamelled glassware. For lead crystal glass, special enamels were used, having even lower melting points than the enamels used on bottles. The lower the melting point of the enamel, the lower its durability and hardness.

As to the thickness of the enamel applied to glass and the adhesion between the enamel and the glass, he said that the enamels were actually glazes; if in the melting the glass was softened, there was a chemical combination between the glaze and the glass, giving rather greater durability than would be the case if the surfaces of the two were merely attached. So that it did not matter, from the point of view of durability, whether the coating was thin or thick. Indeed, in some respects a thin coating was better than a thick one, for it fused into the body of the glassware.

DISCUSSION ON MR. WILLOUGHBY'S PAPER

The CHAIRMAN, bearing in mind Mr. Willoughby's reference to the dust problem in factories, said that the new Act governing conditions in factories enabled much heavier fines to be imposed than was formerly the case for breaches of the law, and it was also very insistent upon the general cleanliness and the good sanitary conditions of works. So that, although primarily it was an Act which consolidated all previous legislation on the subject, he believed its provisions would result in the various works being made fit for human beings to work in. In vitreous enamelling works very special precautions had to be taken to prevent dust arising from sand-blasting; and, having ascertained that an opaque cod-liver oil bottle which Mr. Crook had exhibited had been sand-blasted, he said that presumably the glass technologists had to deal with the same problem. In the vitreous enamelling industry, sand was being used for blasting to a lesser and lesser extent, bearing in mind its possibilities of giving rise to lung diseases, and most of the blasting was done with shot.

A MEMBER asked whether the instrument referred to by Mr. Willoughby for determining the amount of dust in the atmosphere gave a count of the approximate number of dust particles present of a given size or within a range of sizes, say, from 1 to 10μ.

A SPEAKER recalled a remark made by Sir Harold Hartley, the President of The Institute of Vitreous Enamellers, at the annual conference in Birmingham, that the petrographic microscope was of the greatest use in determining the constitution of enamels; he asked if Mr. Willoughby could deal with that further.

MR. J. T. GRAY, who was invited to discuss the occurrence of bubbles in ground coat enamels, said it was true that examination of the surface of ground coat enamels by means of a microscope or even by a good magnifying glass would very often disclose bubbling over the whole of the surface, and when this occurred on the second heating of the enamel, it was often referred to as "after-boiling," and sometimes "re-boiling." He believed it was to some considerable extent due to the gases evolved from the base metal and the effect of the slight oxidation which took place when the ground coat was first fired, but this type of minute bubbling was usually covered by the cover coat enamel.

He asked whether the instruments described by Mr. Willoughby were applicable only to laboratory use as distinct from works use, because the finished surface of enamels (especially when applied to ferrous metals) varied from batch to batch in spite of all the scientific con-

trol employed. This was partly due to the slight variation in the base metal and in some instances might be due to the slight difference in the construction of the enamel. Therefore, if microscopic instruments were to be introduced for the examination of enamelled surfaces, he considered that the enameller would want a strong practical instrument which could be used in the shop for routine testing, so that an examination and check could be made on, say, one in every hundred pieces, or even one in every thousand.

MR. W. THOMAS asked whether there was a method available for checking up strain in enamels applied to sheet iron, such as in hollow-ware, or to cast-iron baths or basins, all of which products incorporated various curves. A method had been mentioned for detecting strain in glass, presumably by polarised transmitted light, and he wondered whether there was an apparatus available using polarised reflected light.

Author's Reply

MR. WILLOUGHBY, replying to the discussion, said that the bubbles occurring in ground coats of enamels were probably due, in some cases at any rate, to inclusions in the metal base to which the enamels were applied, quite probably non-metallic inclusions; hence the importance of the metallography of the metal base.

Dealing with the question concerning the classification of dust particles in the atmosphere according to their size, he said that the Tyndallometer did not measure the number of particles, but rather the content expressed as weight per volume, and usually there was a fairly definite proportion between the numbers of small and large particles. There was no means of differentiating between particles of sizes, say, under and over 10μ; but one could obtain a rough guide. The rate of settlement of dust particles was known. By taking a measurement with the chamber open and the ordinary currents of air in the room or factory passing through, one could measure the total dust content of the atmosphere. Then by closing the chamber and waiting for 15 or 30 seconds or a minute, taking another reading, and calculating roughly the sizes of particles which would by then have settled to the bottom of the chamber, one could judge the number of small particles, and could obtain a rough idea of the proportion present of less than 10μ in dimension. Only the particles in suspension were measured; those which had settled to the bottom were not measured.

He had no experience of the application of the polarising microscope to the examination of the constitution of enamels.

Discussing the applicability of the various instruments to workshop routine testing, he said that certainly the instruments available for surface examination—for detecting cracks, bubbles and other flaws—were all very simple to use. An ordinary bench microscope, fitted with the Ultropak illuminator, could be used by an unskilled worker; that was so again in the case of the binocular magnifiers, where there was a longer working distance and there was no danger of damaging the apparatus. But micrography, and the measurement of lustre and surface properties generally, and the study of macro properties, could not be carried out by the people in the workshop; those were matters to be handled by the laboratory. Such work should be conducted, even if not in a darkened room, certainly in a quiet atmosphere and surroundings, because when matching two fields for intensity, or matching colours, the whole body and the eye should be completely at rest; the observer should be comfortable, and his attention should not be distracted by lights or by people walking about.

Dealing with the question of detecting strains in enamels by means of reflected light, he said he did not know exactly the extent to which strain in enamels produced double refraction, but one could get a measure of the amount of double refraction by reflected light, by using the vertical illuminator with a polariser and analyser. The vertical illuminator had been improved very considerably during the last year or two. Previously quite a lot of trouble was experienced in the de-polarisation of the light, owing to the many reflecting surfaces; but by special design of prisms and reflecting surfaces it was possible to get just as accurate results with incident polarised as with transmitted polarised light, so that the amount of double refraction could be measured. Whether or not that was truly indicative of the amount of strain in the enamel he was not prepared to say definitely.

MR. V. STOTT said he did not follow the explanation that the measurement of the amount of diffraction of light would give a measure of the weight per unit volume of dust in the atmosphere, because if one considered two atmospheres, each containing the same number of particles, but in one of which the particles were of 1μ diameter and in the other the particles were of 10μ diameter, the weight per unit volume in the second atmosphere would be 1,000 times the weight per unit volume in the first. But each had the same number of diffracting particles.

MR. WILLOUGHBY replied that in fact the amount of light diffracted by a particle of a size up to 60 or 80μ—one was interested in particles only up to that size from the point of view of health—was in direct proportion to the size of the particle. But that law did not necessarily hold good for particles of greater size than 60 or 80μ.

Votes of Thanks

On the motion of MR. A. L. MARDEN, seconded by MR. W. THOMAS, hearty votes of thanks were accorded the authors for their Papers, Mr. Faulkner for having presided, and the Science Museum authorities for having provided facilities for the meeting and for their unfailing kindness.

MR. FAULKNER expressed the deep thanks of The Institute of Vitreous Enamellers to the Society of Glass Technology for the invitation to take part in the meeting, and the hope that there would be further joint meetings of the two bodies in the future.

(Concluded from next column.)

or from an analysis, and conversely, the theoretical analysis of a melt. These are followed by three short sections on the admittedly precarious calculation of the specific gravity, coefficient of expansion and elasticity of an enamel from its analysis. Various types of enamel furnaces and muffles are briefly described, and there is a short account of a method of pickling cast iron and of the tests applied to the enamel slip. Enamelling faults are dismissed in two pages, and only three are considered necessary for discussing the most suitable composition of cast iron and the faults likely to occur in the foundry.

Altogether, this is a very unbalanced book. For the laboratory and the mill-room the author does give very clearly every step in the somewhat laborious arithmetic associated with enamel compositions, but he gives practically no help to the foundry manager and enamel-shop foreman who are trying to reduce waste by improvements in foundry or enamel-shop technique. Within the past five years the whole subject of enamelling on cast iron has been revolutionised by the introduction of acid-resisting enamels containing titanium oxide, sometimes applied without a ground coat. The author refers casually to titanium oxide, but seems to be unaware of its distinctive rôle in modern enamels. The recipes given in the appendix are similar to those in general use ten years ago.

It is a pity that a book which is well printed and illustrated, and certainly gives a clear account of enamel calculations, should not have been designed to treat the whole subject in an equally comprehensive manner.

W. E. BENTON.

Book Reviews

Elementary Foundry Technology. Edited by L. A. Hartley, and revised by E. Bremer and Pat Dwyer. Published by the Penton Publishing Company, Limited, Caxton House, London, S.W.1. Price 13s. net.

This is the second edition of this work, which appeared originally in 1928, and was prepared by the National Founders' Association (U.S.A.) under the direction of L. A. Hartley, at that time Director of Education of the Association. In preparing the second edition, all the material has been carefully revised to bring it up to date in the light of present-day practices. Obsolete material has been eliminated, and several new sections have been added, including two chapters devoted to "Gates and Risers" by Pat Dwyer.

This work is regarded as being of value in the teaching of foundry apprentices, and will have a natural appeal to all those who are responsible for the provision of training courses in foundry science. In addition there can be no doubt that a general survey of foundry technology is of very great value, and for this reason the book can be recommended with every confidence to the practical foundryman who requires such a survey in a concise and readable form.

The book is well printed on excellent paper, and maintains the excellent standard associated with the publications of the Penton Publishing Company. J. E. H.

Magnesite as a Refractory. By A. W. COMBER, F.I.C. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 4s. net.

This is the type of text-book which is becoming more and more appreciated by the technologist, as it confines itself strictly to one phase of activity in which the author is really a specialist. That the book is fairly elementary is no drawback, as magnesite has not yet been subjected to the same amount of research as silica—nor, indeed, is it theoretically so complicated in industrial admixture. In reading the book, the attention of the reviewer was drawn to the fact that the appellation "magnesite bricks" is fundamentally wrong, and that in truth they are magnesia bricks, as the entity CO_3, which is basically a part and parcel of the mineral magnesite, is missing. At any rate, to quote the author, "the unqualified description *magnesite* is often accepted as sufficient."

The book pursues the logical order of things by starting with what amounts to "Historical," continues through mineral occurrence, calcination, brickmaking, drying, firing and physical and chemical properties. Then to end the book there are special chapters on electrically-fused magnesite; magnesite in the steel industry; other refractories used and imperial resources. An appendix gives the chemical composition. All this is dealt with in good readable English in twelve chapters contained in 108 pages. The book breaks new ground and the result is a publication which should be welcomed as a concise and authoritative reference book by all users of refractory materials. The elimination of all "padding" is commendable. V. C. F.

Die Emaillierung des Gusseisens. (The Enamelling of Cast Iron). By E. SCHUTZ. Published by Verlag von Wilhelm Knapp in Halle (Saale), Germany. Price: Paper backs, 6.45; bound, 7.35 renten marks.

This book forms a section of a larger work "The Technology of Iron, Steel and Metal Foundry Practice," edited by Hubert Hermanns. The foreword describes the book as being intended for all who are concerned with enamelling of cast iron. This is rather misleading, for out of 150 pages more than half are devoted to calculating the batch composition from a recipe

(Concluded in previous column.)

The Firing of Vitreous Enamels on Glass*

By H. L. CROOK

In dealing with enamelling on glass it seems desirable initially to consider the peculiarities of the materials concerned, as these largely govern the problem. The enamels used are generally soft glazes containing a large proportion of lead, and as such are easily spoilt by chemical reduction. As the organic media by which they are applied readily char if heated too rapidly, the first requisite of the firing schedule is a preheating zone in which the temperature rise is not fast enough

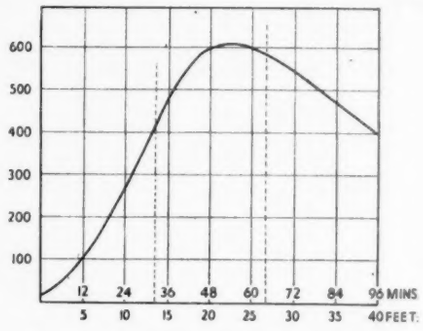


FIG. 1.—HEATING CURVE FOR VITREOUS ENAMELLING OF GLASS.

to form excessive carbon. It is also necessary to have some ventilation to remove the fumes formed.

For the glaze to possess the durability required of modern milk-bottle enamelling, it has to mature at as high a temperature as possible. This is, in practice, the softening temperature of the glass, which is for bottles about 600 deg. C. In cooling from this temperature strain may be introduced into the glassware, and the second requisite is, therefore, a zone of controlled cooling to anneal the glass. Fig. 1 shows a heating curve which satisfies these conditions.

Types of Fuel Available

The types of fuel available are electricity, costing in this country about 1s. 1d.; gas, costing about 4d.; and oil, costing about 2½d. per therm. Of these, electricity is clean and easy to control automatically. Its high cost is offset to a considerable extent by the fact that the full heat content is available, and that it can be used directly in the firing chamber. So that the highly sulphurous waste gases shall not blacken the glaze, oil has to be used in a muffle, with a consequent reduction in thermal efficiency due to poor conductivity of the muffle, high temperature necessary, and large thermal capacity.

TABLE I.—*Performance of Oil Lehrs.*

Width. Inches.	Maximum capacity. Gross.	Average capacity. Gross.	Fuel consumption. Galls.	Cost per gross. Pence.
11	25	20	90	11
20	45	35	100	7½
30	75	55	120	5½

Gas, when used in a muffle, has the same disadvantages; when used directly the flame must be kept highly oxidising, and the waste gases must not be allowed to sweep the ware, again necessitating a loss in thermal efficiency. In the case of both oil and gas the heat carried up the stack in the waste gases is not available, thus increasing considerably the actual price per therm of combustible fuel.

TABLE II.—*Heat Required in Decorating Lehr.*

Estimated for:	75 gross.	67 gross.	89 gross.
Glass	36 kw.	32 kw.	43 kw.
Belt	10 „	9 „	12 „
Radiation	24 „	24 „	24 „
	70 „	65 „	79 „
Actual heat used ..	—	56 „	76 „

Firing Kilns

Passing now to the firing kiln itself, for small quantities of ware small intermittent kilns are used. The author has no personal experience of these, but the cost is usually high; in one case with gas-firing it was 3s. 6d. per gross. For any sort of mass-production work continuous kilns are used, known as "lehrs." These vary from lehrs two bottles wide, decorating 25 gross a day, up to the 7-ft. wide lehrs used in the U.S.A. with a capacity of 500 gross a day. These large American lehrs are mostly fired directly with natural gas, which is an excellent fuel where available on account of its freedom from sulphur.

The first lehr put down at the Charlton factory of the United Glass Bottle Manufacturers, Limited, was made two bottles wide, 11 in. overall; this was followed by lehrs 20 in. and 36 in. overall width. They were fired by oil, using carborundum muffle bricks. They were hand-controlled, and owing to the lag it was somewhat difficult to maintain a constant temperature. Their performance is given in Table I. The 30 in. lehr is illustrated in Fig. 2.

Recently, with the rapid extension of decorating on glass, the company has built a number of 2 ft. 6 in. electric lehrs. These are constructed with the standard castings and plates used in the well-known "Charlton" annealing lehr and, like them, are made to the company's design and supplied to the glass trade by Stein & Atkinson, Limited. The lehrs were designed to take 5½ tons of glass per day, equivalent to

FIG. 2.—APPEARANCE OF 30-IN. WIDE OIL-FIRED LEHR FOR VITREOUS ENAMELLING OF BOTTLES.

75 gross of pint milk bottles. In designing them the electrical energy required was calculated as in Table II, column 1.

The figure for glass is calculated on the basis that all the heat supplied is afterwards lost, the radiation figure referring only to the firing zone. To improve the efficiency a fan was used to blow air from the packing end to the charging end of the lehr. This cools the ware coming out and preheats the ware entering, giving a recuperative saving of heat. As the main heat capacity of the lehr is continuously moving down the lehr, the hottest point tends to move down the lehr, and the fan serves to check this tendency. It also serves to remove all fumes from the lehr, blowing them out at the front. In operation, the amount of blow up has to be regulated to the load. If too much blow up is used, more heat is lost from the front end of the lehr than is saved. Columns 2 and 3 in Table II show the calculated consumption for

FIG. 3.—ELECTRIC LEHR FOR DECORATION OF GLASS.

FIG. 4.—ANOTHER VIEW OF THE ELECTRIC LEHR.

* Paper read before a joint meeting in London of the Southern Section of The Institute of Vitreous Enamellers and the Society of Glass Technology, Mr. V. C. Faulkner presiding.

two actual loads. Both the actual figures are less than the calculated, and this is to be attributed to the use of the fan. It is most marked on the light loads moving at slow speeds where there is ample time for heat transfer to and from the air.

The total length of the lehr is 84 ft. and the electrical rating is 90 kw., of which 15 kw. is under the belt in the preheating section. For light loads, this can be switched off, and only preheating from the blowing air used.

Temperature Control

The lehr temperature is controlled automatically by an indicating controller worked by a thermocouple in the hot zone. By means of a special switch, readings can be taken with this instrument of the temperatures at the other point in the lehr to check the operating schedule. Insulation is by slag-wool, and the balanced weave type of mattress conveyor is used.

The lehr has proved very simple to operate, and can be controlled very much more accurately than the oil lehrs. The running cost per gross of bottles is about 9d. to 10d. Although this appears at first sight large compared with 5½d. for the oil lehr, there are a number of compensations which make the overall costs about equal. They are:—

(1) Owing to its large heat capacity a large amount of fuel was necessary to bring the oil lehr up to temperature, and also the oil consumption was independent of load, making the cost per gross very much higher on light loads. The electric lehr can be brought up in 12 hrs., and the power consumption is very nearly proportional to the load. It is thus very much more flexible than the oil lehr.

(2) Upkeep is much less.

(3) The accuracy of control is invaluable when dealing with fugitive and delicate shades of colour.

In the fourth of these lehrs which has just been put into operation, the preheating and the fast cooling zones have each been lengthened by 6 ft. This gives a slightly greater output, and appears to be giving a lower firing cost. The maximum capacity is now about 100 gross per 24 hrs. Figs. 3 and 4 give an idea of the appearance of the electric lehrs.

In conclusion, it seems opportune to give some idea of the extent of vitreous enamelling on bottles and containers. It is used for three purposes: (1) labelling, (2) decoration, and (3) advertisement.

Enamelling has been used for a long time on milk bottles, where its permanence and washability make it more suitable than paper labels. This application has been recently extended to cover lubricating oil bottles, medicine bottles, beer bottles, whisky bottles and wine bottles. For decorative purposes, glassware can be glazed all over, or designs can be stencilled on tableware.

The use of enamelling for advertising purposes is a new one, originating in the U.S.A., where nearly 50 per cent. of the total production of milk bottles is now treated in this way. Briefly, it consists of using the space on a milk bottle to advertise other goods by means of enamelled designs. It is claimed that, particularly for foodstuffs, this form of advertising has a penetrating power that can be obtained in no other way, as the milk bottle takes the advertisement into the kitchen of every home and keeps it in front of the housewife.

(*Concluded from third column.*)

increase the enamel expansion to the values 320 to 340 × 10^{-7} C.G.S. units. For this reason the author only attempted to mention a few enamels which had optimum opacity, but he gave the practical enamelling expert, who must build up his enamels not only in relation to opacity, the opportunity to select from among a great number of favourable enamels the one most suitable for his special purpose.

Opacifiers for Vitreous Enamels

As correspondence was requested on Dr. L. Stuckert's Paper* which he presented to the Annual Conference of the Institute of Vitreous Enamellers, in Birmingham, Mr. G. H. Abbot, of National Enamels, Limited, addressed a number of questions to the author, and these, together with the replies, are printed below.

Antimony oxide is widely used in commercial enamels for pre-opacification. Can the results obtained in the present investigation be extended to enamels of this type?

It can be expected with certainty that quite similar laws exist for the replacement of silica by antimony trioxide, and also for the additional introduction of it into an enamel melt, as for the experiments made already with silica, fluorspar and silica, cryolite. Thus, for example, it can be accepted without question that a systematic relationship will exist between the acid resistance of the enamel and the added antimony trioxide. The opacity of the enamel also will be related regularly to the added oxide, and probably the firing resistance of the opacity also.

The author is aware that antimony trioxide is used to-day for the opacification of some groups of enamels. This also sometimes happens in Germany; but it is, of course, much disliked, and rightly in the author's opinion, in enamels which come into contact with food and especially with foods where acid liquids are present.

It is certain that antimony trioxide in the hands of an *experienced expert* will give good opacifying results, and especially for enamels which do not come into contact with food it can be used advantageously. But personal investigation by the author was after all concerned only with enamel ingredients *which could be used in general and without any limits in every enamel.* The directions and methods given in the Paper make it an easy matter for anyone interested to determine the relationships for a special case, such as for the use of antimony trioxide.

Can the results obtained from enamels compounded with hydrated alumina, potassium nitrate and quartz be applied safely to enamels compounded from felspar?

It is *not* entirely unimportant whether an enamel is melted from aluminium hydrate, potassium nitrate and quartz, or whether the corresponding amount of felspar is introduced instead of the separate components. In measuring individual properties certain differences are found between the two enamels. But it has always been personal experience, confirmed also by practice, that enamels melted from felspar are better and more constant than those prepared from the separate components, alumina, potassium nitrate and quartz. The reason for this is that free quartz enters into an enamel melt with more difficulty than the silica already present in the felspar. When preparing enamels from quartz instead of felspar it is always necessary to melt longer and at a higher temperature.

It would never have occurred to the author to build up enamels from these three single components of felspar, had the necessity not arisen in the present special case of making a whole series of enamels of varying compositions. All the laws relating to enamel melted from the three separate components can, of course, be extended to enamels containing felspar.

Does the impact test give a better indication of the strength of the enamel than the bending test used in the previous investigation?

In general, enamels should be tested according to the requirements desired in practice. For example, signs, hollow-ware and sanitary ware should be tested for resistance to sudden impact (in practice stone-throwing against signs, hail and dropping; impact in household use, etc.). With enamels on cast iron resistance to bending is never in question, but only their resistance against sudden impact. The more frequent occurrence of impact strains justifies in the author's opinion the use of the impact test both in practice and computation. Moreover, the impact test is more easily carried out than the bending test. If the latter is to give useful and comparable results it requires a mechanical operation such as an enamel works usually does not possess and, because of the cost, cannot afford. In contrast to this the impact test is simple, requires little space, is easy to use and gives quickly a measure of the quality of the enamel. If, in the earlier work, the author used the bending test to compare the strength of enamels, it was because the apparatus was available already in the mechanical laboratory of the Technical High School. A suitable impact apparatus was not available, but was developed in the progress of the last research.

It has been shown that the over-firing of enamels opacified with tin oxide has a remarkable influence on the development of opacity and lustre. Does over-firing similarly influence the chemical resistance of enamels?

The author has not tested yet whether over-firing of enamels also influences their chemical resistance. For the time being he offers his thanks for this suggestion. As soon as time permits, he will make good the experiment and communicate the results.

Does stannic oxide improve the impact resistance, chemical resistance, etc., when melted into the frit?

This question will be investigated exhaustively in the second part of the work, which deals with the results of tin oxide *melted into the frit.*

If commercial tin oxide has a suitable particle-size distribution for the development of maximum opacity, does the author recommend, to prevent further sub-division, that it should be added towards the end of the milling process in ordinary commercial manufacture?

It happens that during milling no real further particle-size distribution is effected which could lead to a *reduction* of opacity. Therefore the author would *not* recommend adding the tin oxide to the mill towards the end of a milling. Certainly no loss in opacifying power takes place if the tin oxide is added as usually with the frit and clay at the beginning of the milling. Only an exaggerated time for milling could perhaps diminish the opacity, but this is excluded, since it would lead to over-fineness of the enamel, which would make it difficult to work and would give rise to all kinds of faults in manufacture.

Has account been taken of the coefficient of expansion of the enamels? Mayer and Havas calculated that the coefficients of expansion of sheet iron cover enamels should be within the limits 327 to 348 × 10^{-7} C.G.S. units. The most favourable composition, No. 43, with 6 per cent. of tin oxide added gives a calculated expansion coefficient of 311 × 10^{-7} C.G.S. units.

Since, with the exception of the extreme members of the series, all the enamels mentioned in the Paper come within the framework of commercial enamels, the special calculation of the coefficients of expansion according to Mayer and Havas was not mentioned. But by small changes of composition (*e.g.*, by exchange of potash for soda) it is a simple matter to alter their expansion coefficients to correspond exactly with the limits of Mayer and Havas. It was pointed out in the Paper that the field of useful enamels in the Gibbs' triangular diagram is so large that enamels can be chosen from other aspects than that of opacity. This also holds good for the expansion of the enamels. Therefore, in a single case it is not difficult—*e.g.*, by removal of a little fluorspar or the addition of a little alumina—to

(*Concluded in first column.*)

* "Stannic Oxide as an Opacifier in Wet Enamels," [FOUNDRY TRADE JOURNAL, November 4, 1937, pp. 359-364.

Optical Aids to the Enamelling Industry*

By A. H. WILLOUGHBY, M.A.

It is well known that the use of optical instruments has during the last decade spread amazingly fast in all branches of industry, where a careful study of the various problems affecting production and the systematic investigation of faults have led to carefully worked-out scientific methods and superseded working by rule of thumb. There can hardly be an industry which has not benefited by having called in the assistance of the optical-instrument manufacturer, and it is the object of this Paper to make a few suggestions as to possible applications of optical apparatus in the glass and enamel industries generally.

In so far as these industries are concerned, optical instruments can be divided roughly into three categories as follow:—

(1) Those used for microscopic examination, *i.e.*, the investigation of raw materials, which includes both metallography and high-power examination of powders, sand, etc.; surface examination of the semi-finished product and surface examination of the finished product, including under the latter heading the behaviour of the structure at elevated temperatures.

(2) Macroscopic examination, by which is meant qualitative and quantitative tests on surface properties over a comparatively large area, *e.g.*, in the case of raw materials, whiteness tests on powders for purity and, in the case of finished products, measurements of lustre, colour and transparency. Under this category might also be included the detection of internal stresses in finished glassware.

(3) The problem of ensuring the best possible conditions of hygiene for works' employees, especially in relation to the presence of harmful dusts in the atmosphere. Incidentally, the presence of dust will also have an adverse effect on the quality of the finished product.

Microscopic Examinations

Turning in the first place to the microscopic examination of raw materials, there is a very large diversity of apparatus. The metallography of enamelling iron is extremely important, since regularity of structure and freedom from inclusions are essential if the ground coat of enamel is to adhere, as it should, to the base. All technologists are familiar with the standard metallurgical microscope, which has been in use for many years past and which usually bears a strong resemblance to an ordinary biological stand, except that it is fitted with a focusing stage and with a vertical illuminator for illuminating solid specimens in place of the substage for transmitted light.

When it is required to make permanent records of one's observations under the microscope, a simple adjunct in the form of a micro-camera attachment will often be found sufficient, but as soon as a large number of tests have to be made as a matter of routine, it becomes imperative to provide some arrangement whereby the whole outfit is permanently set up in rigid form. Hence the evolution of the metallographic microscope, of which the leading models were for many years constructed on the Le Chatelier principle. This type of instrument proved very popular as, in fact, was only to be expected considering there was none other available, but it had certain disadvantages inherent in its construction which adopted the principle of the alignment of all components on an optical bench.

The distance between the arc lamp and the ground glass screen of the camera was such that the worker could not operate the one and examine the image on the other without running backwards and forwards, while the apparatus was necessarily very large and cumbersome, thus occupying much valuable space. Yet it is only quite recently that attempts have been made to remove these objections by radically altering the design of the metallographic microscope. A number of different models were placed on the market at short intervals, but the Leitz Panphot may be said to represent the final solution in that it is extremely compact and therefore easy to use, affords instant readiness, thanks to the permanent centration of all components; yet owing to the interchangeability of the various parts it will perform any task which may be required of it.

Simultaneously with developments in the design of the microscope itself, improvements were made in the method of illuminating the specimen. For many years, the vertical illuminator with prism or plane glass plate as the reflecting element held the field. Here, again, there were certain inherent disadvantages. The reduction of the effective aperture of the objective in the case of the prism reflector and, on the other hand, a certain haze and consequent lack of contrast when using the plane glass plate represented an unsatisfactory compromise. Although many expedients were tried, these shortcomings could not satisfactorily be remedied. They were most clearly noticeable when measuring grain size and when viewing inclusions.

Illumination Improvements

Incident-light microscopy was entirely revolutionised by the advent of the Leitz Ultropak illuminator which afforded the first satisfactory solution of the defects mentioned above. Experiments in this direction had, it is true, already been made, notably in this country by Messrs. Chapman & Aldridge, who marketed a form of oblique incident-light illuminator for many years previously. All these illuminators, however, had certain drawbacks, most of them placing a definite limit on the size of specimen which could be investigated. The Ultropak illuminator, on the other hand, provided a means of obtaining oblique incident light without any limitations whatsoever, whether as regards specimen size or range of available magnifications. It can be used equally satisfactorily from the lowest up to the highest magnifications, up to and including a 1/12 in. oil immersion. The Ultropak at once proved ideal for every kind of incident-light microscopy, either as an adjunct to or, in some cases, instead of the vertical illuminator. The same principle has since been adopted by all the well-known optical firms, for instance, the Univertor, Epi-condensers, etc. The Ultropak can be fitted to the Panphot, or to practically any standard microscope.

Owing to the dark ground effect which it yields on perfectly plane surfaces, it renders much easier the detection of inclusions and, in certain cases, may enable one to differentiate between those which have exactly the same appearance under the vertical illuminator. One example of this is graphite as found in cast iron. Graphite can be recognised by the fact that it remains dark in dark-field as well as in bright-field illumination. If examined under the latter only, it is often difficult to distinguish it from other dark inclusions, whereas most of these will assume a different appearance when viewed with the Ultropak illuminator.

Polarised Light

Polarised light, too, will assist in the detection of anisotropic inclusions either in conjunction with the ordinary vertical illuminator or with the Ultropak. The use of polarised light is also of importance for the microscopy of felspar and the various components of glass, in which cases use is made of a polarising microscope or an ordinary biological microscope with added polariser in the substage and top analyser over the eyepiece.

In the case of enamels, microscopic examination of the semi-finished product is of the utmost importance for detecting flaws and for examining the ground coat of enamel with a view to ascertaining the regular distribution of bubbles. Uneven distribution of the bubbles will have an adverse effect on the quality of the subsequent coats of enamel. For this work, the Ultropak illuminator is ideal, as it throws into marked relief all bubbles, cracks and so forth. For judging the regularity of the distribution of bubbles, magnifications ranging between × 50 and × 250 are most suitable; for the detection of minute flaws and cracks, resort must often be had to the oil-immersion objective and magnifications up to × 1,000.

Surface Examination

Surface examination of the finished product is also carried out by means of the microscope and principally the oblique incident-light illuminator. This examination includes searching for flaws in the final surface. When the surface has a very high gloss, it is found that, even with the aid of the Ultropak illuminator, the image is covered by a haze which renders examination difficult. This haze can be eliminated almost entirely by the use of polarised light, this being available for oblique incident as well as for vertical incident light. In the same way, examination may be made of the finished surface after tests for resistance to attack by acids. Where the enamelled surface is of an irregular shape and surface examination has to be carried out at a level below that of the surrounding material, it is sometimes impossible to approach sufficiently closely with the Ultropak illuminator. In such cases, resort must be had to binocular magnifiers, which afford a long working distance. The maximum magnification attainable at a working distance of over 3 in. is × 40, but they have the advantage of yielding a truly stereoscopic and erect image.

If a cross-section of the material is taken, the thickness of the coat may be accurately determined and any irregularities at once noticed. Here again, the oblique incident-light illuminator, such as the Ultropak, will furnish a much clearer image of the boundary between the enamel coating and the metal base in this connection special measuring microscopes are available. In some of these the specimen is placed on the stage and moved across the field by precision spindles past a reference mark, this latter usually taking the form of a cross-wire in the eyepiece. A more recent development consists in displacing the microscope tube by means of the micrometer spindle, while the specimen itself does not move. This is very convenient when portions of large specimens have to be examined, as it is no longer necessary to section them. A unique feature of the modern measuring microscope with lateral tube displacement is its kinematical design whereby the body moves backwards and forwards on ball-bearings. Such a movement is never affected by the weight of the body tube or any attachment, while at the same time it provides a movement of unequalled sweetness.

Elevated Temperature Examination

Special microscopes are available for examining the behaviour of ceramic materials at high temperatures, either in ordinary or polarised light. Such investigations afford valuable information on heating and cooling processes, devitrification and re-absorption phenomena. The specimen may be heated up to 1,200 or even 1,450 deg. C. for short intervals, and examined at a magnification of about × 42. The objectives used for this purpose are specially made to resist heat, having

* Paper presented to a joint meeting of the London Section of The Institute of Vitreous Enamellers and the Society of Glass Technology, Mr. V. C. Faulkner presiding.

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uncemented components. Such instruments are also useful for observing sintering processes. In addition to the more elaborate heating microscope of the Endell type, simple heating stages are also available for placing on an ordinary microscope stage. They do not allow of reaching such high temperatures, nor have they any provision for accurately regulating the temperature, but they can be used quite satisfactorily for rough checking and demonstration purposes.

Uses of Ultra-Violet Light

Fluorescing properties can be turned to good account, especially in the glass industry where glass which is normally non-fluorescing will exhibit marked fluorescence when in a state of decomposition which cannot be detected otherwise. Imitations of ancient glass by surface treatment are also recognisable in ultra-violet light. Most manufacturers of optical glass claim to be able to recognise their own products by the special type of fluorescence which each exhibits. These special characteristics are, of course, due to individual differences in the constituents of the glass.

In the case of enamels, imitations of period pieces can also be detected. Metallic lustres are nearly always non-fluorescent, while restorations in paint or plaster nearly always fluoresce brilliantly. Here, again, the Ultropak illuminator, when used in conjunction with the luminescence arc lamp, is ideal for those cases when a small area must be viewed in ultra-violet light.

Surface Properties

The measurement of surface properties, *i.e.*, macroscopic work over comparatively large areas, is of real interest, and since practically all these tests can be carried out with one instrument which has recently been placed on the market, it will be as well to explain its working principle very shortly here. The Leitz luminescence arc lamp is a high-power carbon arc in a completely lightproof housing. The emission of the carbon arcs covers the entire visible spectrum and also reaches well down in the ultra-violet. Since the best fluorescence effects are obtained with light of a wave length of approximately 3,500 Å, it is not necessary to use special quartz lenses. Crown glass as used in ordinary objectives and eyepieces transmits light down to 3,300 Å with practically undiminished intensity. The visible light is filtered down by means of a copper sulphate solution, followed by a filter of Woods glass. The fluorescence image observed in the Ultropak illuminator is ideal, since it is entirely self-luminescent and no direct light enters the observer's eye.

Albedo Tests

The Leifo can be used first of all for albedo tests on powders, in which case the new attachment, known as Ulbricht's sphere, is particularly useful, since it furnishes evenly diffused lighting from every possible angle. Even crystalline powders may be determined very accurately. When the whiteness of a perfectly smooth powder has to be measured, it is sufficient to do so under a light incidence of 45 deg., since the albedo is then independent of the direction of the illumination.

The Leifo photometer is arranged in such a way that the light emitted from the lamp is split into two beams by means of a partially silvered prism. One beam passes through or, in the case of opaque objects, over the specimen to be examined. It is thereby reduced in intensity and is then matched in the comparison eyepiece with the other beam, the intensity of which is measurably reduced by means of two polarising prisms, one of which is arranged to rotate against the other. The Liefo can be used for colorimetry, nephelometry (turbidity measurements), *p*H determinations; also for measuring lustre, albedo, opacity and for making trichromatic colour measurements.

In the case of finished enamel surfaces, gloss can be determined under a light incidence of 45 deg. This is now the generally accepted practice for gloss or lustre determinations.

With the Leifo photometer, both components of the lustre, *i.e.*, parallel and at right angles to the plane of incidence, can be determined separately. It is then possible to differentiate between total reflection and diffused reflection. When the degree of lustre is high, the total reflection, *i.e.*, the sum of the light reflected regularly and that reflected by diffusion, may safely be taken as the lustre, since diffusely reflected light is never more than a few hundreds per cent. of the incident light. When the total reflection is very low, however, each component must be determined separately. The absorption of light by coloured and frosted glasses, in other words, the measurement of their transparency, or, better still, opacity, can be made accurately and rapidly.

The trichromatic colour arrangement on the Leifo photometer allows of colour tests on both opaque and transparent surfaces, *i.e.*, enamels and glasses of every type. Such measurements enable one to determine accurately the percentage of each of the three primary colours, *e.g.*, red, green and blue, as well as the percentage of greyness and, in addition, any given colour can be correlated with standards, such as Oswald's Colour Atlas or, alternatively, its position in the colour triangle determined. Where only an approximate measurement is required, the elaborate trichromatic colour apparatus can be dispensed with and the absorption of monochromatic light of one or two different wavelengths determined with the standard filters. From these measurements a graph is plotted showing approximately the colour of the specimen.

Stresses in Glass

The use of polarised light for detecting stresses in glass is too well-known to need any description here. Glass is normally an isotropic substance, but develops marked anisotropy when it has been subject to internal stress. This property can be observed by means of the ordinary polarising microscope, while in large specimens, the use of the newly introduced polarising filters of large dimensions will enable such tests to be carried out more conveniently and at considerably less cost. Projection methods are very useful for this type of work.

Internal Atmospheric Pollution

The final aspect of this subject embraces a far wider field than was assumed until a few years ago. The problem of atmospheric pollution in all its ramifications is one which affects practically every industry as well as the lives of most individuals. Attention has of recent years been focused principally on the dangers to the health of sand blasters and others engaged in similar activities arising from the inhalation of certain dusts which cause diseases of the lungs, of which the most widespread is known under the name of silicosis.

It would be idle to attempt to discuss the various theories which have been put forward in explanation of these lung diseases, at any rate while medical experts and countless others are still attempting to grapple with the problems of their exact origin and effect on the human organism. There seems to be little doubt that they are definitely caused by the continued inhalation of certain dusts. It is therefore of the utmost importance that frequent and careful checks should be made of the dust content of the atmosphere in all industrial undertakings in which the processes used give rise to any kind of dust, unless such has been proved to be entirely innocuous. Only thus can efficacious dust-prevention methods, whether in the form of dust-extraction plant, air-conditioning plant or, as is for instance common practice in underground workings, dust-laying methods by foam or water spraying be assessed.

In this connection it is essential that some method be adopted by which the dust content of the atmosphere can be determined for any given moment, and variations in the dust content followed without loss of time. The instrument must be capable of taking a large number of readings in rapid succession, so that a curve may be later drawn up to show the relation between the dust content of the air and a given set of conditions. Only in this way will it be possible to discover what steps are necessary to avoid unfavourable conditions, *i.e.*, those which give rise to abnormal dust contents.

In all methods of dust measurement hitherto in use, including the well-known Konimeter and the more recently introduced thermal precipitator, dust samples must first be collected on the spot and later examined in the laboratory before they can be evaluated. This means that an average of the dust content of the atmosphere over a given period of time, rather than secular variations, are recorded. Furthermore, the counting-out of dust particles or their measurement (often by simplified methods) is an extremely tedious business, and it has often been found in practice that when the work was entrusted to junior laboratory assistants, they preferred to rely on the general impression of the specimen rather than go through the laborious business of a careful count. Thus it came about that the results obtained were not always as dependable as might be expected from the undoubted efficiency of the apparatus itself.

All these requirements are fulfilled in a well-nigh ideal manner by the newly introduced Tyndallometer. Quite apart from considerations of hygiene and social welfare, freedom from atmospheric dust is of great importance in all industries from the point of view of quality and appearance of the finished product. This applies in no small measure to the enamelling industry, especially during the period immediately after firing. Freedom from dust during the cooling of glass, especially optical glass, which has to conform to very strict specifications, is also of prime importance.

The Tyndallometer comprises a light source fed by an accumulator incorporated in the instrument. The light beam proceeding from the lamp is split into two parts by a glass plate which, at the same time, serves as a window to the chamber of the instrument. This chamber is lined with black glass and the beam after traversing it is completely absorbed by the glass lining on the other side. As soon, however, as any dust or other impurities are present in suspension in the chamber, an amount of light proportional to the weight of the impurities is diffracted and enters the comparison eyepiece, where its intensity can be matched in the comparison beam by the measurable rotation of one of two polarising prisms.

This brief survey of optical aids has of necessity been incomplete and the author must crave indulgence for any gross omissions which he may have made. If, however, he has been successful in directing attention to one or two new aspects of the problem, he will be well content.

Catalogue Received

Welding. An eight-page leaflet received from the Suffolk Iron Foundry (1920), Limited, Sifbronze Works, Stowmarket, Suffolk, describes a new development in the low-temperature welding of cast iron by the Sifonil process. The major difference between the new process and bronze welding is that it creates a weld of exactly the same colour as the parent metal. It is obvious that the new process is a welcome innovation, as colour in the case of welds is of paramount importance.

THE WOMBWELL FOUNDRY & ENGINEERING COMPANY (HOLDINGS), LIMITED, is being wound up voluntarily. Mr. J. H. Gourley, Brincliffe Grove, Brincliffe Crescent, Sheffield, and Mr. G. G. Dickinson, 6, North Church Street, Sheffield, are the liquidators.

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Wherever gas mains are under consideration there is no real challenge to the supremacy of STAVELEY pipes. There is a pipe for every condition of service—a choice from the range of Sand Spun, Metal Spun or Vertically Cast types. In addition to the straight run of pipes there is, of course, the most exclusive range of "specials," and also the famous BAXTER patent pre-cast lead joint which is made under licence by the STAVELEY Company. It represents a most efficient labour and time saver as the lead is already cast in position in the spigot, thus eliminating the lead pot.

PIPES

THE STAVELEY COAL & IRON CO., LIMITED. NR. CHESTERFIELD

WARNER Special PIG IRONS

- Warner C.B.R. and Low Carbon Cylinder (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

● ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO., LTD. CARGO FLEET · MIDDLESBROUGH

The Week's News in Brief

Trade Talk

PRIEST FURNACES, LIMITED, announce a change of address from 123, Albert Road, Middlesbrough, to Longlands, Middlesbrough.

FISHER & LUDLOW, LIMITED, have recently secured a substantial contract from the Government for the supply of pressed-steel ammunition boxes.

EMPLOYEES OF John White & Son, the old-established weighing-machinists and ironfounders, of Auchtermuchty, held their annual social last week.

THE ANNUAL MEETING of Follsain Syndicate, Limited, convened for December 22, was adjourned pending the preparation of a scheme for raising further capital.

DAVY & UNITED ROLL FOUNDRY, LIMITED, announce that owing to re-arrangement of postal areas, their address has now been altered to Empire Works, Haverton Hill, Billingham, Co. Durham.

INVERNESS COUNTY COUNCIL is to oppose the Caledonian Power Bill, the promoters of which are the British Oxygen Company, Limited, who wish to erect a calcium carbide factory at Corpach, in Lochaber.

HENRY ROBB, LIMITED, of Leith, have received two orders for ships for New Zealand owners. One is for a twin-screw coaster of 900 tons for Richardson & Company, the other is for a similar vessel of 800 tons for Anchor Shipping & Foundry Company.

AT AN extraordinary general meeting of the Wolverhampton Die-Casting Company, Limited, a resolution was passed that the company be wound up voluntarily. Mr. W. C. Sproson, Grosvenor Chambers, 73, Lichfield Street, Wolverhampton, was appointed liquidator. and was authorised to consent to the registration of a new company of the same name.

IT IS ANNOUNCED that the business of Mr. Victor B. Reichwald, who died in November in Berlin, will be carried on by members of his family, under the title of V. B. Reichwald (Successors), Limited. The offices have been moved to Norfolk House, 7, Laurence Pountney Hill, London, E.C.4. Mr. Reichwald carried on the business of an iron and steel merchant and agent.

A PAPER ON "The Treatment and Disposal of Trade Waste Waters," by Dr. A. Parker, Assistant Director of Water Pollution Research in the Department of Scientific and Industrial Research, is to be presented at a joint meeting of the Institution of Chemical Engineers and the Institution of Civil Engineers, at the latter's headquarters in Great George Street, London, S.W.1, on January 18, at 6 p.m.

JACKSON, ELPHICK & COMPANY, LIMITED (controlled by Federated Foundries, Limited) have recently opened new offices and showrooms at the entrance to their Avon Works, Larkhall. The new building, which presents a pleasing exterior, has large windows on the ground floor, permitting of a full view of the interior of the showroom. The first floor provides ample accommodation for office work. Floodlighting of the front of the building is to be continued during the winter months. Founded about 40 years ago by the late James Jackson, the firm is now recognised as one of the leading sanitary engineering concerns in Britain, and produces over 1,500 different designs and sizes of enamelled iron baths. The annual production of baths amounts to over 20,000, in addition to many other products. The bulk of these baths are supplied to Scotland. Among special work undertaken by the firm recently was the installation of baths at the Savoy Hotel, London.

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SHOT OR SAND BLAST PLANTS
Rooms, Barrels, & Chambers.
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Personal

THE RT. HON. SIR JOHN ANDERSON, P.C., has been appointed a director of Vickers, Limited.

SIR WALTER ST. DAVID JENKINS has been appointed as an additional director of Metal Industries, Limited.

SIR HAROLD HARTLEY, President of the Vitreous Enamellers, has been awarded the Wilhelm Exner Medal for service to industrial research of the Lower Austrian Association of Commerce and Industry.

MR. W. L. BURNS, managing director of Henry Balfour & Company, Limited, iron and brass founders, of Leven, has been presented with a silver salver by the staffs and departmental heads, on the occasion of his silver wedding.

MR. W. J. MILLAR, a director of the Electric Resistance Furnace Company, Limited, has been appointed managing director, and Mr. A. W. Smith and Mr. A. J. Monks have been appointed sales directors. The secretary of the company, Mr. A. A. White, has joined the board.

Wills

FIRTH, E. W., formerly of Thomas Firth & John Brown, Limited, Sheffield ... £112,236

WILSON, T. K., of Sheffield, a director of Joseph Rodgers & Sons, Limited, cutlery makers £328,161

ROPNER, LEONARD, of Stockton-on-Tees, formerly head of Ropner & Sons, Limited, shipbuilders £760,155

JONES, C. E., of Sheffield, retired departmental manager and buyer of the English Steel Corporation, Limited, Vickers Works £3,488

Obituary

MR. JAMES CRABTREE, managing director of D. Mitchell & Company, Limited, machine tool makers, Keighley, has died, aged 71.

MR. W. G. RAINE, of Monkseaton, chairman of Raine & Company, Limited, iron and steel manufacturers, of Derwenthaugh-on-Tyne, has died at the age of 59.

THE DEATH has occurred, at the age of 68, of Mr. Tom Reynolds, head of the old-established firm of Tom Reynolds & Son, Albion Foundry, Harrowden, Wellingborough.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

474,517. SAMM, G. Moulding-sand mixing-machine.

474,544. HERAEUS-VACUUMSCHMELZE AKT.-GES. Methods of increasing the permeability of silicon iron.

474,552. RENAULT, L. Gas case-hardening furnaces.

474,574. KRUPP AKT.-GES., F. Sintering of finely powdered materials.

474,617. JONES, E. A. Foundry and like riddles.

474,643. RHODES, C. J. Presses for drawing sheet metal.

Contracts Open

Exmouth, January 19.—Cast-iron goods, for the Exmouth Urban District Council. The Clerk.

Bideford, January 19.—Iron castings, cast-iron water pipes, wrought iron and steel, etc., for the Town Council. The Borough Surveyor.

Tunbridge Wells, January 17.—Cast-iron goods, for the Town Council. Mr. H. P. Bishop, borough surveyor, 1 and 2, Calverley Mount, Tunbridge Wells. (Reference No. 12.)

Chelmsford, January 11.—Supply and erection of two centrifugal pumps and electric motors with automatic control, for the Rural District Council. Mr. W. E. Blizard (Lemon & Blizard), 25, Victoria Street, Westminster, S.W. (Fee £2 2s., returnable.)

Darlington, January 17.—Supply and erection of three electrically-driven centrifugal sludge pumps; dual-screen raking gear; electrically-driven sludge evacuator for rectangular sedimentation tanks; 12 revolving sewage distributors, 110 ft. dia., for the Town Council. The Borough Surveyor, Town Hall, Darlington.

Brierley Hill, January 27.—Supply, setting to work, testing and maintenance of treble-ram sewage-type pump capable of delivering 22,000 galls. per hr.; horizontal single-cylinder cold-starting-type heavy-oil engine; centrifugal-type sewage pump, capable of delivering 20,000 galls. per hr., together with electric motor and equipment, for the Urban District Council. Fiddian & Deeley, engineers, 13, Church Street, Stourbridge. (Fee £3 3s., returnable.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Campbell & Gifford, Limited, 17, Victoria Street, London, S.W.1.—Capital, £12,000. Consulting engineers, contractors, etc. Directors: D. F. Campbell and W. S. Gifford.

E.L.S., Limited.—Capital, £10,000. Mechanical and general engineers, etc. Directors: T. B. Eade, W. H. Latchford, Brig.-General S. F. Metcalfe and J. N. Sword, Danes Inn House, 265, Strand, London, W.C.2.

Forthcoming Events

JANUARY 10.

Institute of Metals (Scottish Section):—"Lead—Its Industrial Uses and Mechanical Properties," Paper by J. C. Chaston, at 39, Elmbank Crescent, Glasgow, at 7.30 p.m.

Institution of Mechanical Engineers (North-Eastern Branch):—"Cylinder-Liner Wear," Paper by J. E. Hurst, at the Mining Institute, Newcastle-upon-Tyne, at 6.30 p.m.

JANUARY 14.

Manchester Association of Engineers:—"Some Modern Metallurgical Developments of Interest to Engineers," Paper by Prof. F. C. Thompson, at the Engineers' Club, Albert Square, Manchester, at 7.15 p.m.

Institute of British Foundrymen

JANUARY 8.

Lancashire Branch:—"Patterns and Their Relation to Moulding Problems," Paper by S. A. Horton, at Engineers' Club, Albert Square, Manchester, at 4 p.m.

Wales and Monmouth Branch:—"Some Practical Considerations for Moulders," Paper by J. Pattison, at University College, Cardiff, at 6.30 p.m.

West Riding of Yorkshire Branch:—Annual dinner and dance.

JANUARY 11.

Burnley Section:—Paper by A. Jackson, at Municipal College, Ormerod Road, Burnley, at 7.30 p.m.

JANUARY 14.

Middlesbrough Branch:—"Foundry Drying," Paper by W. H. Smith, at Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough.

JANUARY 15.

Bristol Section:—"Cupola Practice," Paper by S. E. Dawson, at Merchant Venturers' Technical College, Bristol, at 7 p.m.

Scottish Branch:—"Some Aspects of Heavy Castings," Paper by E. Longden, at Royal Technical College, Glasgow, at 4 p.m.

The Institute of Vitreous Enamellers

JANUARY 13.

Midland Section:—"Application of the Radiant Tubular-Element System of Heating," Paper by A. A. Straub, at Chamber of Commerce, New Street, Birmingham, at 7.30 p.m.

The

DIRECTORS

and

STAFF

of

GENERAL REFRACTORIES LIMITED

wish all their many friends

in the

FOUNDRY INDUSTRY

A Very Happy

and

Prosperous New Year

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Russell House,
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Telephone: Temple Bar 3511.
Telegrams:
"Genefax, Rand-London."
(Mr. A. C. Turner).

SCOTTISH OFFICE:
43, West Regent Street,
Glasgow, C.2.
Telephone: Douglas 6108
(3 lines).
Telegrams:
"Genefax, Glasgow."
(Mr. C. A. G. Thomson).

SWANSEA OFFICE:
Metropole Chambers,
Wind Street,
Telephone: 3680.
Telegrams:
"Genefax, Swansea."
(Mr. D. F. Hood-Williams).

MANCHESTER OFFICE:
9, Albert Square.
Telephone: Blackfriars 6130.
Telegrams:
"Genefax, Manchester."
(Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE:
Halifax Bldgs. Exchange Place.
Telephone:
Middlesbrough 3213.
Telegrams:
"Genefax, Middlesbrough."
(Mr. J. A. Williams).

CARDIFF OFFICE:
17, Windsor Place.
Telephone: 5796.
Telegrams:
"Genefax, Cardiff."
(Mr. F. E. Rutter).

Raw Material Markets

Most of the iron and steel producers who stopped work last week in order to carry out essential repair work have again resumed. Despite various indications of a less insistent demand during 1938, works are assured of steady operation over the greater part of the year, as new business already arranged and contract arrears held over from last year are substantial. It seems that the heavy steel works, at least, will continue to work to capacity. There are few export inquiries in circulation at the present time. It is to be hoped that this section of the trade will shortly regain some of the lost ground, as, although the lack of inquiries may not be so much felt now, a good volume of export business is essential if the future is to be made secure.

Pig-Iron

MIDDLESBROUGH.—New business in this area has continued to be very quiet, as only inquiries for small tonnages can be considered. Makers are concentrating chiefly on the disposal of old contracts, although they have taken on quite a large number of orders for delivery over the first half of this year. Owing to the shortage of supplies of foundry iron in this district, consumers are compelled to seek elsewhere for their requirements. The loyalty rebate scheme, of course, prevents them from negotiating further with producers overseas, but they have been able to do a fair amount of business with makers in the Midlands, despite the fact that the iron obtainable from this source is not always so suitable for their purposes as Cleveland iron. Prices of No. 3 Cleveland G.M.B. for delivery during the January/June period of this year are as follow:—109s. delivered Middlesbrough or Falkirk, 111s. delivered on Tyneside and 112s. in Glasgow. No. 1 foundry is quoted at 2s. 6d. above the foregoing figures, while No. 4 foundry and No. 4 forge are 1s. per ton less.

Consumers of hematite have not been slow to book their requirements and business for deliveries over the first half of the year has already assumed substantial proportions, output being well accounted for at many of the producing works. Foreign trade has still to be curtailed, but exports are as heavy as possible in existing circumstances. East Coast mixed numbers are quoted at 132s. 6d. on the North-East Coast, 138s. delivered Sheffield and 143s. 6d. for delivery in the Birmingham area.

LANCASHIRE.—It appears likely that rather better deliveries of pig-iron will be made shortly in this area. Activity at some of the consuming plants has declined recently and additional tonnages should become available for distribution to other sources where the need is greater. Producers were able fully to maintain operations over the holidays in most cases and, as many consumers were idle, small stocks were accumulated. For delivery in the Lancashire price zone over the first half of the year, offers of Staffordshire, Derbyshire and Lancashire brands of No. 3 foundry iron are on the basis of 114s., with Northamptonshire No. 3 at 112s. 6d., and Derbyshire forge iron at 111s. to 113s. per ton, according to the class of consumer. West Coast descriptions of hematite are quoted at 141s. for delivery in the Manchester district over the first six months of the year, with East Coast material at 140s. 6d. Scottish foundry iron is scarce at 141s. per ton.

MIDLANDS.—Compared with conditions at present ruling in other districts, the supply position in this area is very satisfactory. In nearly every case consumers are obtaining good deliveries and complaints of shortage are few, and are chiefly concerned with hematite. As a result, some producers are despatching supplies to other parts of the country, where less favourable conditions prevail. Caution is being exercised, however, as it is fully appreciated that as soon as more work is received by the light-castings makers and other concerns who are not so active as they were a few months ago, there will be no surplus of iron available. For delivery to Birmingham and Black Country stations during the first six months of the year, ordinary foundry iron is quoted at £5 8s. 6d. for Northamptonshire No. 3, with Derbyshire No. 3 at £5 11s. per ton, less 5s. rebate. The price of low-phosphorus iron is not controlled at from £6 7s. 6d. to £7 10s., according to quality. Refined iron is quoted at a minimum of £8 5s. East Coast No. 3 is quoted at £7 3s. 6d., with West Coast mixed numbers at £7 4s. 6d., delivered Midland stations.

SCOTLAND.—The New Year holidays are being celebrated in this area at the present time, but they are being curtailed to as short a period as possible. Consequently, new business has not involved heavy tonnages and the market generally has been quiet. Scottish No. 3 foundry iron is still quoted at 118s. f.o.t. furnaces, with No. 1 at 120s. 6d. No. 3 Cleveland is at 109s. at Falkirk and 112s. at Glasgow, but these figures are only nominal, as no supplies are available. Deliveries of pig-iron to the steelworks have been satisfactory. For delivery to local steelworks and subject to a rebate of 5s. per ton, mixed numbers of hematite are quoted at 133s., with Scottish basic at 107s. 6d. and English and Indian basic at 100s.

Coke

It is understood that Midland ironmasters have entered into contracts with coke producers for the supply of blast-furnace coke for twelve months at 30s. per ton on rail at the coke works, an advance of 2s. 6d. upon the prices recently operating under the sliding-scale agreement. Current deliveries are not as satisfactory as might be desired, but generally the demand on the foundry-coke market is being adequately dealt with. For delivery in Birmingham and district, best Durham foundry coke is quoted at 55s. 9d. per ton, on open-market sales, with Welsh at from 55s. to 65s., according to quality.

Steel

The steel market has been under the influence of holiday conditions, and little new business has been transacted, says the official report of the London Iron and Steel Exchange. In most districts the break was curtailed in order to meet the heavy pressure exerted by consumers to obtain delivery. In a number of cases, however, repairs to plant had become an urgent necessity, so that a somewhat irregular restart was made. The situation in the semi-finished steel department is gradually improving, although supplies are still tight. The production of the British works continues at a high level, but remains insufficient to meet the market's requirements. Lately, however, increased imports have eased the situation. In the finished steel section, pressure to obtain deliveries was maintained up to the commencement of the holidays and resumed immediately afterwards. The works have heavy accumulations of orders in hand, and the greater part of their output for the first quarter of this year appears to have been disposed of. There has been some inquiry for far forward delivery, but most producers and consumers are reluctant to undertake such commitments.

Scrap

Owing to the holidays, business has been on the quiet side again this week. No relaxation in the demand, however, appears to be apparent and consumers are still anxious to take up supplies as they become available. Steelworks, particularly, are keen to acquire as large tonnages as possible. There is little demand for machinery cast-iron scrap and stocks have accumulated in many cases.

Metals

The non-ferrous metal markets opened quietly after the holidays and demand has been small. It will be interesting to see what effect Mr. Roosevelt's speech at Washington on Monday will have on the markets. Stocktaking is now in full swing, both in this country and in the United States.

Copper.—It is generally agreed that stocks at the consuming plants are on the low side, and that after the stocktaking operations have been carried out, there will be a spell of substantial buying. Business has been rather better than had been anticipated after the holidays, but stronger conditions are expected to prevail in a few weeks' time, when working is more normal. Consumers in the United States have continued their policy of keeping aloof from the market. An Ottawa report states that copper production in Canada during the month of October created a new record at 51,853,071 lbs., as compared with 48,045,881 lbs. in September, which was the previous highest output.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £39 5s. to £39 6s. 3d.; Friday, £39 7s. 6d. to £39 10s.; Monday, £39 8s. 9d. to £39 11s. 3d.; Tuesday, £39 15s. to £39 16s. 3d.; Wednesday, £40 18s. 9d. to £41 1s. 3d.

Three Months.—Thursday, £39 10s. to £39 12s. 6d.; Friday, £39 13s. 9d. to £39 15s.; Monday, £39 12s. 6d. to £39 15s.; Tuesday, £39 18s. 9d. to £40; Wednesday, £41 3s. 9d. to £41 5s.

Tin.—It is still difficult accurately to gauge to what extent discussions on the possibility of a buffer pool being reintroduced have gone. While it was generally thought in this country that a revival of the buffer pool was likely to materialise early this year, a report from Amsterdam states that nothing has occurred recently to justify the conclusion that opinion in Malaya regarding the proposed pool had changed. It is also denied that discussions regarding the pool had taken place recently. The report goes on to say that even if Malaya now regarded the buffer pool more favourably, any discussions would last a considerable time, so that the speedy creation of such a pool would be impossible.

Dull conditions have prevailed in this country and also in the United States, where the tinplate mills, usually heavy consumers of tin, are operating at very low levels. The mills in this country are working at around 76 per cent. of capacity, while deliveries are appreciably less than the output.

According to Mr. W. H. Gartsen (Henry Rogers, Sons & Company), the total visible supply of tin at the end of December was 19,614 tons, against 18,067 tons on November 30. The carry-over in Straits Settlements was 4,388 tons and 3,676 tons respectively, while the carry-over at the Arnhem (Holland) smelter was 1,709 tons and 1,584 tons respectively.

Official quotations were as follow :—

Cash.—Thursday, £183 5s. to £183 15s.; Friday, £181 15s. to £182; Monday, £181 5s. to £181 10s.; Tuesday, £181 15s. to £182; Wednesday, £186 10s. to £186 15s.

Three Months.—Thursday, £183 to £183 10s.; Friday, £181 15s. to £182; Monday, £181 5s. to £181 10s.; Tuesday, £181 !0s. to £182; Wednesday, £186 5s. to £186 10s.

Spelter.—The outlook over the first few weeks of the year, at any rate, is not too promising, and demand so far has been disappointing. Until the stocktaking operations have been disposed of, little improvement can be expected. The position at the galvanising plants is not very encouraging, and it is reported that one of the largest works in the country has closed down for two weeks instead of the customary week owing to lack of orders. The American market remains in a depressed condition, the absence of stability on Wall Street still being an adverse factor.

Daily market prices :—

Ordinary.—Thursday, £14 17s. 6d.; Friday, £14 15s.; Monday, £14 10s.; Tuesday, £14 12s. 6d.; Wednesday, £14 18s. 9d.

Lead.—This market remains the most active of all the non-ferrous metals and, taking into account all the factors which are at present affecting the markets, the condition of lead is satisfactory. The fact that building operations are on the decline is causing some misapprehension, for it must not be overlooked that this is partly due to the scarcity of raw materials and that as soon as this problem has been overcome the industry will again become more active.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15 10s.; Friday, £15 10s.; Monday, £15 2s. 6d.; Tuesday, £15 3s. 9d.; Wednesday, £15 15s.

Scrap.—This section of the metal market has not yet recovered from the effects of the recent vacation and business has been very small. A better tone is likely to rule within a few weeks. Prices remain about unchanged, with the exception of aluminium foil, which is slightly lower on the week.

Approximate selling prices for old metal:—New aluminium cuttings, £82; rolled, £67; cast, £40; foil, £92 to £94. Copper, £37 to £41; braziery, £36. Brass (clean), £24 to £26. Zinc, £9. Lead, £15 5s. Gunmetal, £39 to £40.

ALUMINIUM CASTING ALLOYS

for every purpose

The British Aluminium Company produces aluminium alloys individually suited to all requirements. Here is a selection.

BA/Y FOR EXTRA STRONG CASTINGS

BA/23 FOR ANODISING

BA/42 FOR LOW EXPANSION PISTONS

BA/40D FOR DUCTILE CASTINGS

BA/40J FOR INTRICATE WORK

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P.T.J. 6/1/38

RAW MATERIALS—PRICE LIST

(Wednesday, January 5, 1938)

COPPER

	£ s. d.
Standard cash	40 18 9
Three months	41 3 9
Electrolytic	45 5 0
Tough	43 18 9
Best selected	44 8 9
Sheets	75 3 9
India	54 18 9
Wire bars	45 13 9
Ingot bars	45 13 9
H.C. Wire rods	49 3 9
Off. av. cash, Dec.	39 19 8½
Do., 3 mths., Dec.	40 4 3 9/11
Do., Sttlmnt., Dec.	39 19 6 5/11
Do., Electro, Dec.	44 10 4 4/11
Do., B.S., Dec.	44 8 7 7/8
Do., Wire bars, Dec.	45 2 11 5/11
Solid drawn tubes	12½d.
Brazed tubes	12½d.
Wire	8¼d.

BRASS

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	9d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8d.
Yellow metal rods	6d.

TIN

	£ s. d.
Standard cash	186 10 0
Three months	186 5 0
English	186 10 0
Bars	188 10 0
Straits	190 0 0
Eastern	186 10 0
Banca (nom.)	—
Off. av. cash, Dec.	190 12 1 5/22
Do., 3 mths., Dec.	189 18 8 7/22
Do., Sttlmt., Dec.	190 11 9 9/11

SPELTER

	£ s. d.
Ordinary	14 18 9
Remelted	11 15 0
Hard	11 5 0
Electro, 99.9	18 13 9
English	15 15 0
India	14 10 0
Zinc dust	23 5 0
Zinc ashes	6 0 0
Off. aver., Dec.	15 7 0 3/8
Aver., spot, Dec.	15 5 5 34/44

LEAD

	£ s. d.
Soft foreign, ppt.	15 15 0
Empire (nom.)	16 1 3
English	17 15 0
Off. aver., Dec.	15 15 5 35/44
Aver., spot, Dec.	15 18 11 79/88

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£ s. d. to £ s. d.
Zinc sheets, English	28 0 0 to 28 10 0
Do., V.M. ex-whse.	28 0 0 to 28 10 0
Rods	22 5 0

ANTIMONY

	£ s. d. to £ s. d.
English	81 0 0 to 82 0 0
Chinese, ex-whse. (nom.)	64 0 0
Crude, c.i.f.	37 0 0

QUICKSILVER

Quicksilver	13 0 3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	14 10 0
45/50%	12 0 0
75%	17 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va
Ferro-molybdenum—	
70/75% carbon-free	4/9 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	9/3 lb.
Tungsten metal powder—	
98/99%	9/6 lb.
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	24 5 0
6/8% car.	24 0 0
8/10% car.	24 0 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£18 15 0 to 19 5 0
76/80% packed	£19 15 0 to 20 5 0
76/80% export	£22 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 10d.
Finished bars, 18% tungsten	5s. 0d.

Per lb. d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£ s. d.	£ s. d.
South Wales (West)—		
Heavy steel, best	3 8 9	to 3 11 3
Mixed iron and steel	3 6 9	to 3 9 3
Heavy cast iron	3 8 9	to 3 11 3
Good machinery	3 17 6	
Cleveland—		
Heavy steel, best	3 7 0	to 3 9 6
Steel turnings	2 13 0	to 2 15 6
Heavy cast iron	4 5 0	
Heavy machinery	4 10 0	
Midlands—		
Short heavy steel	4 0 0	
Light cast-iron scrap	3 2 6	
Heavy wrought iron	4 0 0	to 4 5 0
Steel turnings	2 6 3	to 2 8 9
Scotland—		
Heavy steel, best	3 5 0	to 3 7 6
Ordinary cast iron	4 5 0	to 4 7 6
Cast-iron borings	2 0 0	to 2 3 0
Wrot-iron piling	4 15 0	
Heavy machinery	4 10 0	to 4 12 6

London—Merchants' buying prices, delivered yard.

	£ s. d.
Copper (clean)	32 0 0
Brass	23 0 0
Lead (less usual draft)	13 10 0
Tea lead	11 0 0
Zinc	8 0 0
New aluminium cuttings	71 0 0
Braziery copper	29 0 0
Gunmetal	32 0 0
Hollow pewter	130 0 0
Shaped black pewter	95 0 0

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
,, No. 3	109/–
,, No. 4	108/–
Forge No. 4	108/–
Hematite No. 1	133/–
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/–
,, d/d Birm.	144/6
Malleable iron d/d Birm.	165/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/–
,, No. 3 fdry.	111/–
Northants forge	107/6
,, fdry. No. 3	108/6
,, fdry. No. 1	111/6
Derbyshire forge	110/–
,, fdry. No. 3	111/–
,, fdry. No. 1	114/–
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/–
Cleveland No. 3, Glasgow	112/–
,, ,, Falkirk	109/–
Scottish hem. M/Nos. d/d	133/–
Sheffield (d/d district)—	
Derby forge	107/6
,, fdry. No. 3	108/6
Lincs forge	107/6
,, fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/–
Staffs fdry. No. 3	114/–
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/–
Glengarnock, No. 3	141/–
Clyde, No. 3	141/–
Monkland, No. 3	141/–
Summerlee, No. 3	141/–
Eglinton, No. 3	141/–
Gartsherrie, No. 3	141/–
Shotts, No. 3	141/–

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/– per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£ s. d.	£ s. d.
Bars (cr.)	13 5 0	to 13 15 0
Nut and bolt iron	11 12 6	to 12 2 6
Hoops	14 2 6	
Marked bars (Staffs) f.o.t.	15 15 0	
Gas strip	14 2 6	
Bolts and nuts, ¾ in. × 4 in.	17 10 0	and up
Steel—		
Plates, ship, etc.	11 8 0	to 11 10 6
Boiler plts.	11 18 0	to 12 0 6
Chequer plts.	13 0 6	
Angles	11 0 6	
Tees	12 0 6	
Joists	11 0 6	
Rounds and squares, 3 in. to 5½ in.	12 0 6	
Rounds under 3 in. to ⅝ in. (untested)	11 9 0	
Flats—8 in. wide and over	11 5 6	
,, under 8 in. and over 5 in.	11 10 6	
Rails, heavy	10 2 6	
Fishplates	14 2 6	
Hoops (Staffs)	12 4 0	
Black sheets, 24g. (4-t. lots)	15 15 0	
Galv. cor. shts. (,,)	18 10 0	
Galv. flat shts. (,,)	19 0 0	
Galv. fencing wire, 8g. plain	20 5 0	
Billets, soft, 100-ton lots	7 17 6	
Sheet bars	7 15 0	
Tin bars	7 15 0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	13½d.
Tubes	18½d.
Castings	15½d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2¼ to 1/8¼
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	37/6
Durham foundry	38/6
,, furnace	37/6
Scottish foundry	42/6
,, furnace	40/–

TINPLATES

f.o.b. British Channel ports.

I.C. cokes 20×14 per box	22/6
,, 28×20 ,,	45/–
,, 20×10 ,,	35/–
,, 18¾×14 ,,	25/–
C.W. 20×14 ,,	19/– to 20/–
,, 28×20 ,,	38/– to 40/–
,, 20×10 ,,	30/3 to 31/–
,, 18¾×14 ,,	21/3 to 21/9

SWEDISH CHARCOAL IRON & STEEL

	£ s. d. to £ s. d.
Pig-iron	£12 0 0 to £13 0 0
Bars-hammered, basis	£20 0 0 to £22 0 0
Bars and nail-rods, rolled, basis	£19 0 0 to £20 0 0
Blooms	£18 0 0 to £19 0 0
Keg steel	£30 0 0 to £35 0 0
Faggot steel	£20 0 0 to £25 0 0
Bars and rods dead soft st'l	£19 0 0 to £20 0 0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Dec.	30 ..	39 5 0 inc.	7/6
,,	31 ..	39 7 6 ,,	2/6
Jan.	3 ..	39 8 9 ,,	1/3
,,	4 ..	39 15 0 ,,	6/3
,,	5 ..	40 18 9 ,,	23/9

Electrolytic Copper

		£ s. d.	
Dec.	30 ..	43 0 0 inc.	20/-
,,	31 ..	43 10 0 ,,	10/-
Jan.	3 ..	43 5 0 dec.	5/-
,,	4 ..	43 10 0 inc.	5/-
,,	5 ..	45 5 0 ,,	35/-

Standard Tin (cash)

		£ s. d.		
Dec.	30 ..	183 5 0 inc.	45/-	
,,	31 ..	181 15 0 dec.	30/-	
Jan.	3 ..	181 5 0 ,,	10/-	
,,	4 ..	181 15 0 inc.	10/-	
,,	5 ..	186 10 0 ,,	95/-	

Tin (English ingots)

		£ s. d.		
Dec.	30 ..	183 5 0 inc.	45/-	
,,	31 ..	181 15 0 dec.	30/-	
Jan.	3 ..	181 5 0 ,,	10/-	
,,	4 ..	181 15 0 inc.	10/-	
,,	5 ..	186 10 0 ,,	95/-	

Spelter (ordinary)

		£ s. d.		
Dec.	30 ..	14 17 6 No	change	
,,	31 ..	14 15 0 dec.	2/6	
Jan.	3 ..	14 10 0 ,,	5/-	
,,	4 ..	14 12 6 inc.	2/6	
,,	5 ..	14 18 9 ,,	6/3	

Spelter (Electro, 99.9 per cent.)

		£ s. d.		
Dec.	30 ..	18 10 0 dec.	1/3	
,,	31 ..	18 8 9 ,,	1/3	
Jan.	3 ..	18 6 3 ,,	2/6	
,,	4 ..	18 7 6 inc.	1/3	
,,	5 ..	18 13 9 ,,	6/3	

Lead (soft foreign, prompt)

		£ s. d.		
Dec.	30 ..	15 10 0 No	change	
,,	31 ..	15 10 0 ,,	,,	
Jan.	3 ..	15 2 6 dec.	7/6	
,,	4 ..	15 3 9 inc.	1/3	
,,	5 ..	15 15 0 ,,	11/3	

Lead (English)

		£ s. d.		
Dec.	30 ..	17 10 0 No	change	
,,	31 ..	17 10 0 ,,	,,	
Jan.	3 ..	17 5 0 dec.	5/-	
,,	4 ..	17 5 0 No	change	
,,	5 ..	17 15 0 inc.	10/-	

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 8	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 8	6 17 8	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	12 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 7	10 6 8½	
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	8 10 0	8 8 9	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 6 0	8 7 6	8 6 10½
1934	8 8 1½	8 10 7½	8 16 6	8 17 6	8 6 3	8 6 3	8 5 7½	8 5 0	8 5 0	8 5 0	9 5 0	9 5 0	8 11 0
1935	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1936	9 5 0	9 5 0	9 5 0	9 5 0	9 8 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 18 1	9 12 7½
1937	10 0 6	10 0 6	10 0 6	10 0 6	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 5 3

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND

FERRO-SILICON—FERRO-CHROME

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED

FOUNDRY FOREMAN or Assistant Manager desires change, with drawing office, patternshop and foundry experience, in general, cylinder and machine moulding.—Box 732, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager (33), 17 years' experience (principally non-ferrous), 9 years executive control, seeks situation in any district. Sound technical knowledge and commercial experience. Excellent references. Disengaged.—Box 722, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

IRON MOULDER wants job. Exp. in medium castings preferred.—T. H. LEWIN, 83, Whitethorne Ave., Yiewsley, Middx.

ASSISTANT Metallurgist required for iron foundry. Must be experienced in analysis of iron and steel, and capable of controlling furnace charges and operation. Experience of rotary furnaces an advantage. Midlands. State age, experience, and salary required.—Box 726, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN (Grey Iron) wanted; able to control production and quality from 100 bench and machine moulders on plate, oddside and loose pattern work. Big salary to really smart man. Apply stating age, experience, and terms to: Box 730, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

LARGE mining company requires services of competent Metallurgist as Superintendent of sintering plant abroad. Must have recognised technical education and practical metallurgical training, together with experience in sintering iron ores and similar materials. Liberal salary and leave, and permanent employment for suitable man. Age limit 40 years. Write full particulars and copy testimonials to: "N.C.," c/o J. W. VICKERS & Co., LTD., 24, Austin Friars, E.C.2.

LONDON Representative required by Scottish firm making cast-iron pipes. Age 25/35. Apply, giving experience and stating salary required, to: Box 728, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AGENCY

AGENT for sale of high class grey-iron castings in Yorkshire wanted by Staffordshire Ironfoundry. Good prospects. State age and proposed terms and details of experience to: Box 724, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

NOTICES

ARMY CONTRACTS.

NOTICE IS HEREBY GIVEN that Tenders for Goods and Services of the kinds mentioned below are invited from time to time, as required:—

Metal Trades:—

Building materials, Cutlery, Enamelled-ware, Hardware, Hollow-ware, Ironmongery, Machinery and Plant, Metals ferrous and non-ferrous, Precision machining, Tinware, Tools, Tubular scaffolding, Vehicles, Wire, Wire rope.

Electrical, Optical and Scientific Instrument Trades:—

Cables, Electrical plant, Electrical and wireless stores, Scientific and optical instruments.

Textile Trades:—

Blankets (brown, grey and red), Braid and lace, Canvas and canvas goods, Clothing (made up from the Department's own materials),

(*Continued in next column.*)

NOTICES—*Continued*

(*Continued from previous column.*)

Cotton piece goods and cotton goods, Cordage, Flags, Head-dresses, Hosiery, Linen piece goods, Sewing silk, Shirting (wool and cotton mixture), Silk cloth and webbing, Towels, Woollen cloths.

Foodstuffs.

Coal and Coke.

Other Trades:—

Badges and buttons, Basket-ware, Bedding, Boots and shoes, Brooms and brushes, Chemicals and oxygen and acetylene gases, China and earthenware, Furniture, Glazed-ware drain pipes, Harness and saddlery, Leather and leather goods, Linoleum, Medical supplies, Moulded rubber articles, Musical instruments, Oils and spirits, Paints and varnishes, Refractories (firebricks, etc.), Road materials, Rubber boots and clothing, Safety glass, Sanitary appliances, Stable fitments, Timber, Woodware.

Building Works, etc.:—

Jobbing, painting and repair work (including term contracts), New buildings, Hot-water heating and electrical installations, Erection of constructional steelwork, Reinforced concrete work, Road parade and drainage work, Roofing and flooring work, Construction of sports grounds, etc.

Firms NOT already on the War Office List of Tenderers, who wish to be invited to tender for the above Army requirements as they arise, should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1, for Form I (Form I.A. in respect of the services mentioned under Building Works above), on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods or carry out services for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have employed or purchased from them and are in a position to certify as to the quality of their work. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on February 16, 1926:—

> "That, in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment, to the fullest possible extent, of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

Sales:—

From time to time the Department has for sale surplus Army Stores of various descriptions, among which may be mentioned Boots, Clothing, Electrical and wireless stores, Chemicals (including drugs, ammonium nitrate and sodium picrate), Harness and saddlery, Hutting, Machinery, Medical and dental stores, Motor vehicles and spare parts, Optical and scientific instruments, Scrap metals, Textile goods, Veterinary stores.

Firms who wish to be invited to tender for the purchase of surplus stores should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1.

Sales of surplus stores by auction are also held at the Royal Arsenal, Woolwich, about the middle of January, March, May, July, September and November. Catalogues may be obtained from the Chief Ordnance Officer, Royal Arsenal, Woolwich, S.E.18.

NO APPLICATION IS NECESSARY FROM FIRMS WHOSE NAMES ARE ALREADY ON THE WAR OFFICE LISTS, UNLESS THEY HAVE EXTENDED THE RANGE OF THEIR MANUFACTURES.

H. C. GORDON,
Director of Army Contracts.

NOTICES—*Continued*

UNIVERSITY OF LEEDS.

DEPARTMENT OF COAL GAS AND FUEL INDUSTRIES (WITH METALLURGY).

SPECIAL Courses of Evening Lectures will be given during January, February and March as follows:—

MANUFACTURE OF COAL GAS—Mr. R. Dally, M.Sc., Mr. F. J. Dent, Ph.D., and Mr. H. Hollings, M.Sc., A.I.C., M.Inst.Gas.E.

REFRACTORY MATERIALS—Prof. J. W. Cobb, C.B.E., B.Sc., F.I.C., and Mr. A. L. Roberts, Ph.D.

DISPOSAL OF WASTE LIQUORS PRODUCED IN GAS WORKS AND COKE OVENS—Mr. A. Key, Ph.D.

ENGINEERING METALLURGY—Mr. A. Preece, M.Sc.

Further particulars may be had from The Registrar, The University, Leeds, 2.

MACHINERY

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
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